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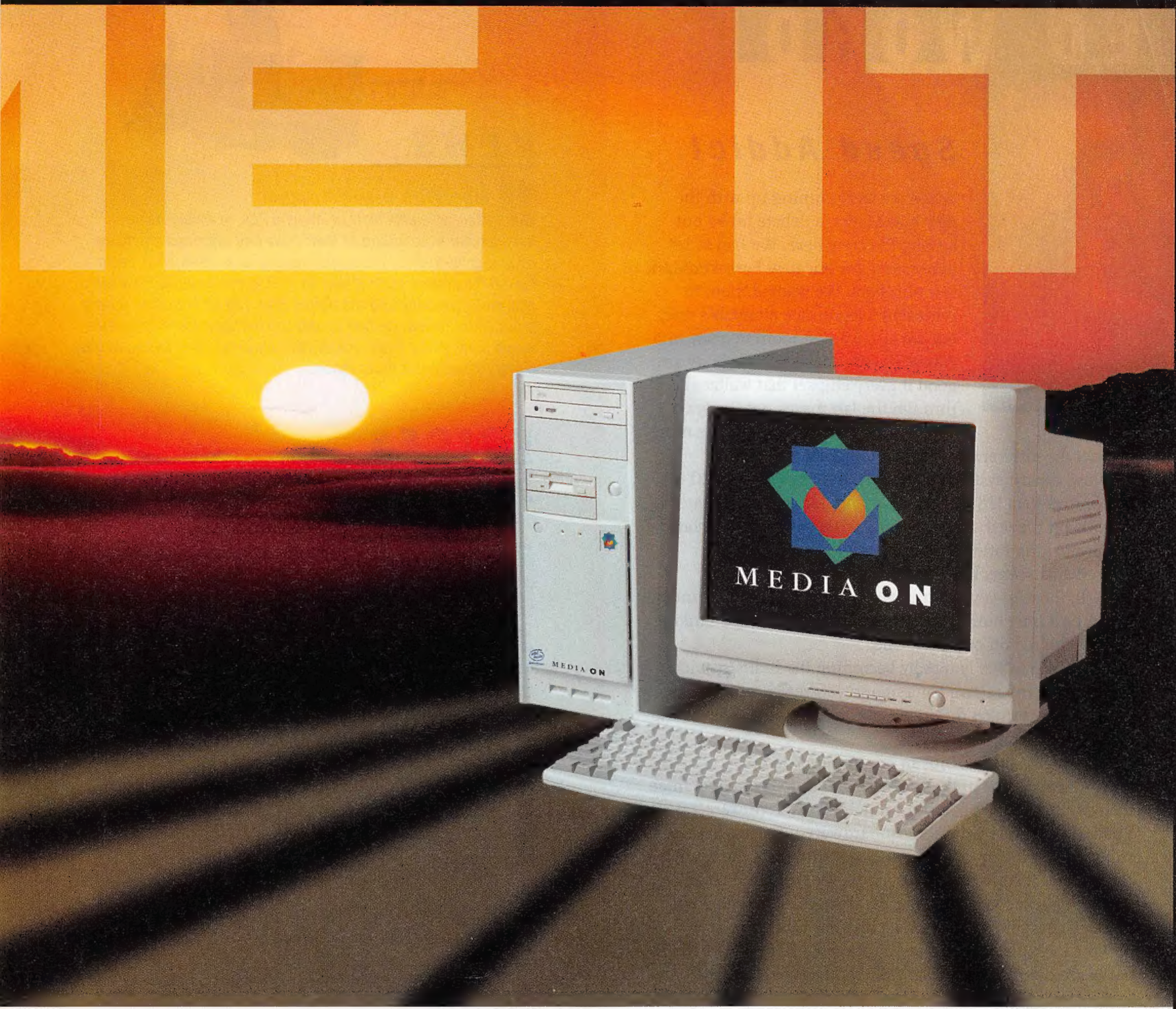

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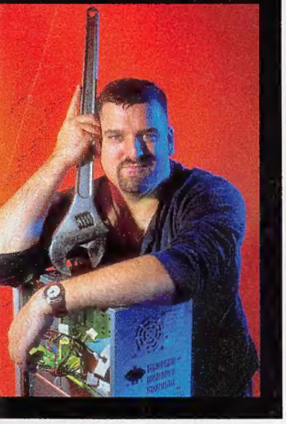

Speed Addict

When we were coming up with the new bootMarks, a debate broke out among the crew here. We had to set parameters for our new ForsakenMark test numbers. We wanted them to represent a legitimate attainable rate, but we also wanted room to grow into. A benchmark doesn't do anybody any good if every chipset that waltzes through the lab maxes out the scale. And the narrower the range, the more distinct the differences between products.

Now, typical systems gave us frame rates around 20 to 30fps. And Riva 128–based cards were kicking frame rates in the 60s on the test. And our early trials with 3Dfx's Voodoo 2 were returning rates in the triple digits.

So 60fps seems like the natural midpoint, right?

Well, those of you without all this spankin' new technology might be a little bummed to find your pride and joy ranking deep in the red on our new scale.

And since 60fps is rapidly becoming the industry-wide standard for interactive content and you really can't even visually detect much difference above that point, why set the top mark so high?

Who really needs 90fps in any game? You do.

You need 90fps in the ForesakenMark today to guarantee that you'll have the power to run tomorrow's software. Voodoo 2 outruns today's most hardware-intensive games, so software developers can raise the bar. And raise their polygon counts, and texture map sizes, and level sizes, and so on.

The biggest complaint we hear from readers who have invested their life savings into a kick-ass rig is how six months later, that same system feels pokey and outdated. The hardware didn't wear down. The world moved forward.

Technology travels in one direction: forward. You may save a buck by buying behind the curve, but you're doing so at the expense of the life span of your system. That sub-$1,000 PC may run more or less everything you want it to today, but tomorrow? I guarantee you're going to load the latest digital video, or image editor, or 3D renderer, and it'll crap out on you. Or the game that's everyone buzzing over won't run for you.

It's a fact of life. Just ask the person living with a 486.

Sure, someone out there will cry out, "But all I do on my PC is file recipes, and I'm perfectly content with my 486." Well, rock on and more power to ya. But for the rest of us who want to ride the bleeding edge of this mad race (or just enjoy front-row seats, if the budget doesn't allow us to be behind the steering wheel), we need 100fps. We need the most MHz Intel or AMD can throw into a CPU. We need it all, and we're going to get it.

Brad Dosland
Editor in Chief

Falcon Northwest
MachV, page 74

NEWS

14 bootWire **News** that **matters.**
With the surge in popularity of low-end PCs, many big-name manufacturers are **killing of their high-end offerings** or limiting them to built-to-order direct-mail venues. boot takes an in-depth look at the current spate of sub-$1,000 technologies. ALSO Months ago, when we **criticized the nVidia Riva 128** for immature drivers provided for review, we had no idea the backlash these comments would draw. We've meet with nVidia's top people and looked at the current drivers. This is our report.

VOICES

23 The Saint **Alex St. John** reveals his **darkest secret** about DirectX and the hidden truth behind OpenGL.

27 Game Theory **T. Liam McDonald**'s mad as Hell about game companies ripping us off with **half-assed products** that ship before they're finished.

29 On the Line **Shel Kimen** examines just how free the **free speech** promised by free e-mail services really is.

31 Fast Forward **Tom Halfhill** takes you along on his painful three-year journey through the **torment** that could strike any of us: RSI.

104 Glitch **Jon Phillips** rummages the **basement** of the boot building in **downtown** Manhattan to find out what ever happened to the old Glitch cast.

DEPARTMENTS

5 Comm Port Readers air out the **buzz** via e-mail, fax, and pope cards.

12 bootDisc Your guide to the **joys** of our shiny silver platter. A sampling of this month's bounty includes: Video Driver Madness! PLUS Wing Commander Prophecy, Madden 98, FIFA 98, G-Police, Turok Dinosaur Hunter, Daytona USA Deluxe, NBA Action 98, PC Anywhere 32, and much, much more.

20 Pure Lust **Tech** toys for digital girls and boys.

60 12-Step/Clinic Want a few more fps out of that old **3Dfx** card to tide you over until Voodoo 2 hits? We've got your solution: **Overclock** that bad boy! Simply follow our 12 easy steps to faster frame rates. ALSO A slew of tips and techniques to soothe your burning sensations in this month's Clinic.

66 bootWorthy You've got the killer system, with the killer graphics and the killer speakers, but now consider the source. You need a **killer soundcard**. And no matter what your needs, we've got just the card for you in this roundup of the soundcards deemed bootWorthy.

VICam Color Digital Video Camera, page 88

CONTENT

P/REVIEWS

70 Previews *The 3D world has been holding its collective breath waiting for the impending **3D chipset from goliath Intel**. We have one of the first slabs of silicon and run it through the grinder.*

73 Reviews *The review boot readers have demanded: Falcon Northwest's **"ultimate" game system**, the MachV goes head-to-head with the bootMarks, and nothing will ever be the same again.*

ALSO:
- *—id's **Quake II** frags as one of the most anticipated games ever.*
- *—Rendition's new breed of 3D accelerators comes of age, and we have two more **V2200-based cards**.*
- *—Tired of just looking at other's 3D creations? Make your own with **Ray Dream 3D**.*

FEATURES

50 Jock Itch

***Football**. Baseball. Soccer. Racing. Hoops. Finger jams. Groin pulls. **Theismann-like snappage**. If you get your jollies by manipulating the hearts and souls of **pixilated athletes**, it's time to **bust a move** toward our biggest **sports sim roundup** ever. That's right, baby, jock itch will **drive you nuts**!*

pentium II
PROCESSOR
intel

34 Centaur's Glenn Henry

*They call him **Mr. Chips**, and he's **challenging Intel** with the **WinChip C6+**, a low-cost **Socket 7–compatible CPU** optimized for Win95 and DirectX. Listen to the **maverick** celebrate his **built-in 3D acceleration** while he knocks Andy Grove and the **"marketing ploy"** called MMX.*

54 Welcome to Speed Country

*You **ain't seen speed** until you've seen the new **333MHz Pentium II** processor work its **magic mojo**. We've got the **shocking benchmarks** scores and all the **info** you'll need to **upgrade** to Intel's new CPU architecture. And did we mention these babies **overclock** like a mother?*

***Cover** System Photograph by Aaron Lauer*

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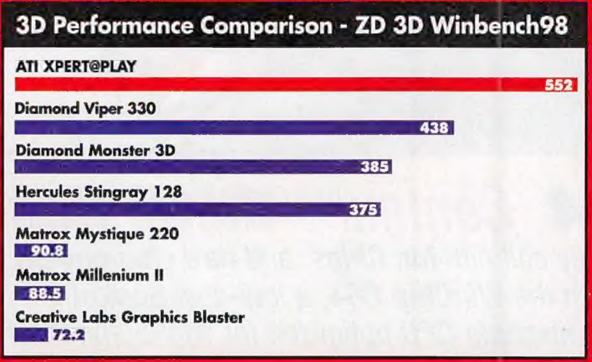

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COMM PORT

Jurassic Guru

I just wanted to give a few words of praise to a magazine that has rekindled an old passion of mine. I used to think of myself as a computer guru. All my friends were in awe of my knowledge of computers. The only problem is that the industry moves so fast, it's almost impossible to keep up. Things like AGP, MMX, 3Dfx, and other terms leave my head spinning. Then I picked up an issue of *boot.* I was surprised (and delighted) at the amount of information contained within its pages. I began to feel the stirring of a passion I had not felt in years. I felt that I could once again claim I was "computer literate."

Thank you for keeping this "dinosaur" from becoming extinct. Your magazine is just the thing for us "ol' timers" who remember COBOL, FORTRAN, and assembly, to evolve.

Chris Hampton

Bird Of Prey

Falcon Northwest seems to talk all talk, but I would like to see its machines put in the scrupulous hands of *boot* magazine. *boot* is the authority in the world of hardware, as compared to any ZD pub, whose reviews seem to be directly related to the amount of advertising a company does. I find it difficult to swallow their reviews. If Falcon's product really does kick ass, then let's see the guys down at *boot* tear it up and see who the real winner is.

Howard West

Editor in chief Brad Dosland replies: *Ever since we looked at one of Falcon's systems waaay back in* boot *02, we've wanted to fly one again. Luckily, the folks at FNW finally consented to our repeated requests, and we have one reviewed in this very issue. Check it out on page 74.*

"Falcon Northwest seems to talk the talk, but I would like to see its machines put to the scrupulous hands of boot magazine."

Bus Speed Limits

Does the 440BX AGPset give a true 100MHz speed throughout the bus or 50MHz, as with our current 66MHz/33MHz bus?

Also, whatever happened to the Lockheed-Martin R3D chipset?

Rafael Garcia

Senior editor Andrew Sanchez replies: *From what Intel has told us, your PCI bus will still run at 33MHz (for compatibility's sake), while the system bus (memory subsystem, etc.) will run at 100MHz (or 33x3=99MHz).*

As far as Lockheed-Martin's R3D technology, you'll be seeing a variation of it surfacing with Intel's i740 Auburn 3D accelerator. Take a peek at page 70 for an info-packed preview and initial benchmark results—they may surprise you!

K6+3D=Multiple FPCs

I have some questions about the K6+3D. I understand that the K6+3D has an internal 3D processor. Will this additional 3D processing increase rendering performance when raytracing images? Additionally, if the 3D features within the chip support real-time 3D graphics, how will it work in conjunction with other video cards? What APIs (if it requires any) will it support? Is this some useless processing device similar to MMX, or is it an entirely new CPU architecture that may no longer be x86 compatible?

William

Senior editor Andrew Sanchez replies: *AMD's K6 3D contains 24 new instruction sets specifically designed to accelerate floating-point computations, where multiple FPCs can be processed in a single clock cycle. This should speed up the front end of the graphics pipeline, where stuff such as gaming physics, geometry transformation, clipping, lighting, and even a bit of triangle setup will be handled by these new instructions. Meanwhile, the K6+3D throws in on-chip, full-speed L2 cache and other enhancements. As far as rendering performance with raytraced images, that will depend on the applications—it will naturally render faster due to the faster clock speeds and increased FPC performance, but in order to take full advantage of the K6 3D's new instructions, the application must be programmed specifically for them, just like MMX. The 3D features will work with other 3D accelerators—remember, the K6+3D will accelerate the front-end of the graphics pipeline, while the 3D accelerator will take care of triangle setup (if applicable) and the pixel rendering stage. API support as of this writing includes DirectX 6.0.*

And don't worry, the K6+3D is fully x86 backward compatible, so you can bust out your ol' copy of Ultima IV *and play it till you puke.*

Thesaurus Rex

Have you ever counted the number of times "ass" is written in the magazine? Please give your writers a thesaurus. Technically, *boot* is great and reviews awesome computers. With such a high-profile magazine, please assume a leadership role and realize that many young people read these mags and the writers are role models, whether they realize it or not (or care).

Ray Pace

Window Cleaning Tips

Regarding your 12-Step in *boot* 16:

When you make a boot disk and copy AUTOEXEC.BAT and CONFIG.SYS to the startup disk, check for AUTOEXEC.DOS and CONFIG.DOS instead, if running Win95, as those would not be modified while in Win95, but only when booting to a previous version of MS-DOS.

Also, before frying your HD, boot up with your nice new startup disk and make sure

COMM PORT

you can access your CD-ROM drive. Also, if using the *.DOS config files, make sure highscan is not on the emm386 line.

Ken Tope

I just finished reading your 12-Step on cleaning Windows and was wondering if there was any way to keep my drive partition when I put my restore disk in.

Michael Gomez

Technical editor Sean Cleveland replies: *Sure, just skip Step 8.*

DirectOS = AmigaOS

The Saint's DirectOS (*boot* 17) sounds so much like an OS I have been using since 1986: AmigaOS, a multitasking OS that can run from a floppy and machines designed so the OS can be bypassed by those who would like to hit the hardwire directly.

Dr. Larry Keller

While I agree that an OS could be written better than Windows 95 is, I can't really understand comments about pre-emptive multitasking. "How many times are you really running three or more apps concurrently and being productive?"

How many times are you working while an Internet download is in the background? Have you ever rendered an image and wrote a letter at the same time? Or perhaps you want to compile something while continuing to work on the code.

Even when multitasking doesn't actually make you more productive, it at least gives you the feeling that you have some control. You don't have to just sit there and stare at your monitor while your computer copies some file.

The times when you're not likely to do any multitasking are actually when you're being least productive, i.e., you're playing games (and I'm not talking about the fortunate few whose job is to play games) or benchmarking your system, or something like this. I assume that's where Alex's point of view comes from.

And as for pre-emptive multitasking being expensive, I can't understand why. The Amiga did it pretty well on a 7MHz CPU with an OS that fit into 256K of ROM (later 512K), and didn't need megabytes of memory to function. Sure, it didn't implement virtual memory or memory protection, but it wasn't much less stable than Windows 95, which does implement them. AmigaOS also lets programs disable multitasking, which was perfect for games that wanted to squeeze every last ounce of speed from the system (i.e., most of them). And they could, of course restore multitasking, too.

What I'm saying is—just because a feature is problematic under Windows doesn't mean it's a bad idea for an OS. It's a real pity that good technologies don't always win the day. Both the AmigaOS and the 68000 chip were far more elegant than their Microsoft/Intel counterparts.

Eyal Teler

In the Saint's recent column (*boot* 17), he mentioned creating a new OS without all this backward compatibility. I support him, if only we could start over completely. Get rid of the IRQs, DMAs, and 640K of low RAM. If we could create a new PC and OS with just SCSI, PCI, 3D, DVD, and all the other new and cool technologies, then have a powerful NT-style OS that wasn't a resource hog. I must be dreaming.

Joseph Jones

KICK
ASS!
PRODUCT

> "Have you ever counted the number of times '**ass**' is written in the magazine? Please give your writers a thesaurus."

Saint Praise

I'm a true fan of the Saint's column—direct, hard hitting, and crammed full of insider goo right from the frothing horses mouth! God I love it. It makes me wonder just how many more of those Microsoft monkeys secretly share his professional and personal attitudes toward Microsoft.

I'm sure quite a few of those working in the Redmond Lockdown know in their heart of hearts that it should and could be done better. But if I was getting $75,000+ for hammering out line-after-endless-line of code and linking them gracefully together with endless and bloated Dynamic Link Libraries and calling it an OS, I wouldn't be too inclined to bite the hand of my feeder.

Matt Livingstone

Hack Naked

I'm a computer science student who also holds a full-time job. Why? I'm pumping hundreds of dollars into my machine every month. In the past year and a half, I've blown a $3,500 hole in my savings. All that money just trying to keep up. It seems no matter how much I bleed out, it's never enough. The worst part is that I'm looking to buy a 3Dfx Voodoo Rush card and *boot* 17 is already talking about Voodoo 2. Voodoo 2 ? I thought Voodoo Rush was the latest gizmo! And when is Voodoo 3 coming? Six months after Voodoo 2?

What really ticks me off is the freaking ignorance of all the DVD makers. Obviously people responsible for DVD technology have no clue what (power) freaks like me go through to keep up. We are afraid to buy because of incompatibilities in the industry leaders' products.

Thank God I'm not married. I'd either still have a 486 or hold divorce papers in my hand after a recent trip to the computer store (my best friend, Visa).

The pace of development and the money that goes with it create software piracy. After investing money in new speakers and a new monitor, I found myself unable to buy good games (I need a new jeans—my only pair is not taking four washes a week very well). This, of course, is not an attempt to excuse warez. I know I'm not the only one to invest hundreds of dollars in my computer while walking in a ripped up pair of jeans and shoes with holes.

Pawel Opala

A Case For Scully And Mulder

I have a bitch. The 24x ATAPI CD drive reviews in *boot* 17 are in conflict with those in *boot* 14. In particular, the Toshiba XM-6102B benchmarks look completely unrelated.

Was this due to a different testbed? Different version of CDTach? Different "bus mastering" drivers? Unexplained UFO phenomenon? Or some other reason left out of the small print?

Derek Blakley

Technical editor Sean Cleveland replies: *You got it right with the different testbed. When we review comparable hardware, it's done on the same system. With the newer drives (in boot 17), we were unable to recreate the original testbed. We tried, but got different scores on the Toshiba drive (which won the first round in boot 14). It would be unfair to Sony and USDrive if we put them up against the Toshiba with the original scores, as they were much better, so we re-benchmarked the Toshiba to level the playing field. We then used the bootVerdict of the Toshiba drive (6) as a basis for the scores of the other two drives. We apologize for not clarifying this in the review.*

From Deep In The Heart Of Toshiba

I work in a plant that produces nearly all of Toshiba's desktop computers, and I think your review of the 7260 in *boot* 17 was right on target. I have asked engineers why we were bulking a machine with a 6.4GB HD and only using most of it. They didn't even seem to know about FAT 32. One even laughed at me and thought I was off my rocker. For the record I have proven him wrong on this and many, many other occasions, but it sometimes gets frustrating being only a technician making tech pay, when these bozos are making double the salary with half the knowledge.

We also build several more computers for many of the top companies. We build the motherboards for Intergraph, also reviewed in 17. The dual-P-II board is called "Stingray" in house. If you guys liked that system, you should see one of Intergraph's other motherboards. This sucker has no less than four P8 sockets and 32, yes 32, SIMM sockets onboard!

Kartr Higgins

K6 O'Clock

Ever since *boot* 05, I've been wanting to try overclocking, but have been afraid. Today I overcame that fear. I'm running my AMD K6 166MHz at a speedy 200MHz. I have the feeling before this is all said and done I'll push it toward 233MHz. It's running good so far, with minimal "warmth."

My IWill P55XB2 motherboard documentation says "The jumper mark as 'T75' on the JP7 is reserved for engineer used only to easy test and change the bus clock from 60/66 to 75 bus frequency as a over clock jumper, you are not recommend to use the over clock function as it may unstable your system." (These aren't my not typos!) How do you get this to work? Before moving my CPU jumper from 166 to 200, I tried this "T75" jumper. My system hung.

Also, my Award BIOS has an "SDRAM Speculative read" option. What is that?

Patrick Coy

Technical editor Sean Cleveland replies: *You are correct. To run the system at 75MHz, you only need to put a jumper on "T75" of JP7. When you tried it, you were effectively running the system at 187.5MHz. Pushing the CPU and the bus speed may have been too much for your system. Try running the system at 150MHz with the bus set to 75MHz. You will lose 16MHz on the CPU but may find the system to be faster anyway. It will at least prove that the motherboard and its components can handle a 75MHz speed. If that doesn't work, it may mean one of the PCI cards in your system can't handle the speed increase. As for the "SDRAM Speculative Read" option, according to Award it means "The chipset can 'speculate' on a DRAM read address, thus reducing read latencies. The CPU issues a read request containing the data memory address. The DRAM controller receives the request. When this field is enabled, the controller issues the read command slightly before it has finished decoding the data address."*

W8 St8

With all the news on upgrade paths for Socket 7 owners, those of us with Pentium Pros (Socket 8) feel left out. Is there any hope for a CPU upgrade, or are we left in the silicon dust?

Jim Sayer

Senior editor Andrew Sanchez replies: *Intel hasn't totally forgotten 'bout you Socket 8 power users out there—Intel has informed us that a Pentium Pro Overdrive Chip with MMX extensions will be available sometime in 1998, so you can rock on with MMX just like everyone else. Other than that, once Slot 2 Deschutes is released, the Pentium Pro will stroll with regular ol' non-MMX Pentiums into the silicon sunset.*

To Kill A Mechingbird

In regard to your online news item of 12.16.97 regarding FASA's giving up development of *Mechwarrior 3* to Zipper: "The development team at FASA Interactive that dropped the ball on *Mechwarrior 3* has, ahem, been reassigned to other products . . . "

I'd like to say that the *MW3* development team at FASA never "dropped the ball." There were artists, programmers, designers, and producers who worked for well over a year on that project and busted their butts to make a great game. Anyone who saw the game would tell you it looked great.

Unfortunately, many times, bigger-picture issues between developers and publishers can kill a project.

Heinz Schuller, Lead Artist
FASA Interactive

Microsoft Versus The World

I'm eating my breakfast and watching the morning news when who appears for an interview—none other than Ralph Nader, and the topic of the day was Microsoft. He whined about vaporware, predatory pricing, web browsers, blah, blah, blah. Did he make good points? Yes. Did he make bad points? Yes. Do I care? No. Let them include whatever they want in Win9x. If I don't like *IE4*, I'll download the latest version of Netscape and install it. We all have our opinion of Microsoft (actually I think we all have a common one), but enough is enough.

As for Nader, maybe Microsoft could build an exploding gas tank into Win9x and give Nader a real reason to go after the company.

Jonathan Pilgrim

"Maybe **Microsoft** could build an exploding gas tank into **win9x** and give **Nader** a real reason to go after the company."

Eight-Headed Monster

I hear that Windows 98 and NT5 will be able to support up to eight displays using different video cards. Now, I only have one PCI slot left and I'm saving that for a 3D add-on card. Are motherboard manufactures planning on adding more PCI or even more AGP ports in the future now that almost everything is going PCI (e.g., soundcards)? I could use a second display, since I am always running out of screen real estate.

Eric Sales

Senior editor Andrew Sanchez replies: *A well-known mainboard maker recently showed us a forthcoming design that'll have one AGP, five PCI, and one shared ISA/PCI slot, for a grand total of six usable PCI slots! But, until someone gets off his butt and designs an AGP bridge chip, you're stuck with that one AGP slot. I've personally asked Intel to give you more AGP slots, but as of right now, is sees AGP as a single-slot solution.*

It's Not Easy Being Cheesy

I think *boot* should sponsor me... you know like skateboarders get sponsored and stuff? But instead of getting cheesy wheels and trucks, I should get 3D cards and motherboards. And I should represent *boot* at COMDEX. My mom said she would make you guys some bomb California rolls (she's Japanese) if you hooked me up.

And my mom thinks Jon Phillips is cute . . .

James McClarty

Editor in chief Brad Dosland replies: *Sponsorship, huh? Some grommet shredding the floor of COMDEX street style in the name of* boot? *Massive air over the show floor? Backside grinds down the rails at the IBM booth? Hmm. It could work. Before doing the boot drill, I was an editor at* Thrasher *mag for quite a few years, so I get your drift. 'Course, you'll have to drop out of school and travel the country in a beater '64 Impala . . .*

And by the way, our executive editor is a swingin' single, and we encourage all our younger readers to send him photos of their (preferably single) mothers for his consideration.

Tweaky At High Speeds

I have a 166MHz with MMX (I overclock it to 200MHz) and the 430VX chipset. It's pretty quick, but I want more speed. I'm thinking about getting a 430TX chipset capable of 83MHz bus speed. Is it worth getting the 430TX chipset, or should I just get a Pentium II?

Sonyman

Senior editor Andrew Sanchez replies: *The 430TX is notoriously tweaky about running at speeds faster than 66MHz—you'll need to find a 430TX mainboard that supports a higher bus speed and is stable at that speed. If you plan to stay in Socket 7, try dabbling with a non-Intel chipset such as VIA VP2/VP3 or others—they'll support bigger L2 caches and faster system-bus speeds. But if you want to take the Pentium II plunge, go for something in either the 440LX or 440BX flava.*

Mission: Impossible

I fail to see how you could possibly assign the Micron Transport XKE anything over a 5, as the Micron system only has 2MB of video RAM. This is an utter sham that Micron is trying to foist off on the unsuspecting public. I called Micron about this. The salesperson I spoke to was nice; however, he tried to lead me to believe that 2MB of video RAM could, somehow, display 16-bit color at 1024x768. This would be physically impossible. (If you add up the bbp and res, you get more than 2.3MB, which does not include setup and draw overhead, as well as a myriad of other things needed by video memory.)

I made him check, and he found that it will only do 256 colors at 1024x768.

To top that off, he said "Well, few people run at 1024x768" Oh really? So why does the LCD screen run at that resolution? And this being a "Power Notebook," it's probably meant to replace a desktop system anyway. Hence, you might want to put on an external monitor at some point.

To add insult to injury, they don't even make a full docking station for this machine, just a measly port replicator.

The Gateways 9100 series machine has everything the Micron has, plus 4MB of video memory, at the same or lower price. Top this off with a 233MHz Tillamook chip, a full docking station, a 14.2-inch screen (which Micron does not offer), and an integrated CD-ROM/floppy, and the Gateway blows the doors off the Micron any way you slice it.

Josh Zerlan

News editor Bryan Del Rizzo replies: *Our XKE 233MHz supports 1024x768@16-bit color just fine. At 800x600, you can bump up the color-depth to 24-bit. But for the record, both machines are terrific and are heartily recommended. And yes, the floppy/CD-ROM combo on the Solo 9100 is positively cool.*

However, as good as the Solo is, the Micron XKE is even better. Its overall performance beat the Solo hands down. The wavetable audio was sweet as the pure driven snow; and the battery provided juice for well over three hours (more than an hour more than the Solo 9100). Also, if you check out the review in boot 14, you'll realize Micron's port replicator is hardly "measly." With features such as an Ethernet LAN adapter, S-Video and NTSC video-out ports, built in stereo speakers, and a cool way to charge the battery, we'd call it nicely robust.

More Voodoo 2 Qs

The preview of the 3Dfx Voodoo 2 was great, but it still leaves many questions still open (especially if you have a high-end monitor [21-inch] and need to know what to expect).

1. What will the AGP Voodoo 2 do that the PCI can't (other than 1024x768/16-bit)?
2. When will the AGP part be available (how long afterward?)
3. What should people interested in buying a 2D/3D board and a Voodoo 2 do?
4. What graphics card would you suggest if you have a 21-inch (or a 19-inch) monitor?

Kjohn Sasitorn

Senior editor Andrew Sanchez replies: *More Voodoo 2 questions! Hold on to yer hats, 'cause here we go...*

1) AGP Voodoo 2 will allow faster transfer of 3D data such as vertex information and triangle data, but other than that, not too much else (besides the aforementioned resolution).

2) As we go to press, the only vendor who's announced a Voodoo 2 AGP part is California Graphics, with its Wizard 3D. Armed with TV-outs and 12MB of video memory (four per fx2 chip), it's slated for Q1 of this year.

3) You should wait until Voodoo 2 comes out. Make sure you're running a utility that allows switching between video cards such as 3DCC.

4) If you have a massive 21-incher and want to run at high resolutions and refresh rates, look either into the Matrox Millennium II armed with 8MB of WRAM, or Number Nine's Revolution 128 with 8MB of RAM—they may be 3D weak, but boy can those things push razor-sharp high resolutions without giving you the 60Hz headache from Hell.

Boo On Voodoo

For the past few months, the bootDisc has contained Voodoo-specific software. I feel that by this, *boot* is not addressing the majority of readers. You cannot expect your clientele to go and purchase hardware for the sole purpose of taking advantage of your bootDisc.

Unless *boot* wishes to lose the majority of its readers, refrain from providing hardware-specific software. I hope my comments do not fall on deaf ears, and that there will be an improvement in software provided by your magazine.

Richard

Technical editor Sean Cleveland replies: *We realize not everybody has this hardware, which is why we put hardware-accelerated versions along with the nonaccelerated versions on the disc. Yes, a lot of 3Dfx games have been released lately, and support for it is at an all-time high. We would be doing those readers who own this hardware a disservice if we did not include these optimized versions. Expect to see content that takes advantage of Rendition and PowerVR hardware as well. Also expect to see the latest drivers for these cards, along with patches to the latest games. boot only reviews games that take advantage of the latest technology and hardware, and it only makes sense for the bootDisc to support them as well.*

Card-Specific Direct3D

If a game is designed for Direct3D, shouldn't it work with any 3D accelerator, provided the 3D card supports the DirectX API? I own a Matrox m3D and have found, much to my displeasure, that many games say they are Direct3D but require a specific 3D chipset.

Wasn't DirectX created to eliminate the need to worry about hardware requirements? Wasn't it created to bring all types of hardware into one scope, allowing a general path for game developers to follow, thus enabling the use of any 3D accelerator with their games?

Is the game company's declaration of support for Direct3D wrong then? Or should I scream at Microsoft for this?

James Addison

Columnist Alex St. John replies: *D3D was created to allow 3D games to run on just about every 3D card. No, it doesn't often work that way in practice. Card manufacturers still have to make D3D drivers for their cards, and they often do a poor job of it. Game developers still need to test their games on a range of 3D cards to make sure they work properly, but many must check for D3D drivers for particular 3D cards they like and only run on them, even if other cards have perfectly valid D3D drivers. In your case, the Matrox is a particularly limited 3D card that does not support texture mapping. I'd imagine most games would reject it for lack of that functionality, even if it does have a D3D driver. D3D can't give your hardware functionality it doesn't have.*

You're suffering from one of the biggest problems with PCs for consumer entertainment. There are no standards for defining multimedia support for a PC system. It's all determined by the wild-west free market and a thousand vendors all independently making different components, bolting them together, and hoping they get along. Something is always broken. I tried to get a project going at MS called "Funstones" to create a standard support and compatibility suite for all MM systems that would make it easy for consumers to identify a quality MM system from a broken one. Unfortunately, consumers aren't high on Microsoft's priority list.

Software Scam

Software houses are ripping us off big time. I recently sent an e-mail to Bethesda concerning the "half-assed" game *Battlespire*. What a piece of rhinoceros excrement! The game didn't even work out of the box. I had to go to the web site and download a patch to get it working. Smells like the "*Daggerfall* Patch Fiasco" to me. Boy! The bean counters sure couldn't wait to collect that Christmas cash could they? What happened to the 3Dfx support Bethesda was claiming in its magazine ads? What a rip off! I waited months and paid $60 dollars for an alpha? And Bethesda is not the only one doing it! I am tired of software companies breaking the law. These companies are committing fraud, plain and simple! They are using the old "bait and switch" tactic. Companies talk about how wonderful their game is going to be and then give us a game that has more bugs than a bait store. Does a consumer buy a washing machine and have to wait for a patch to use the spin cycle? Does a consumer buy a toaster and have to wait until the power cord comes out to use it? I think not. The FTC should hear about it. As part of the gaming community, we should be boycotting these companies and putting them out of business.

BATTLESPIRE

"I am tired of software companies using the old '**bait and switch**' tactic. We should be boycotting these companies and putting them out of business."

When Nintendo, Capcom, or Konami make a game for a console system, the game has to be 100% complete before it goes to cartridge or CD. Why should it be any different for PC software? It shouldn't! Because we have re-writable storage capabilities is no excuse. The game industry needs to realize that we will wait for perfection. We may fidget in our seats a little, but I'd rather be antsy and impatient than receive an unfinished alpha version that won't have full functionality for six months.

Scott T. Myers

COMM PORT

What To Stick In AGP

I have a dilemma. My video plans are an ATI All-In-Wonder Pro and the Voodoo 2. Would the AGP bus be better used for the ATI (which supports 2x/DMA and sidebands) or the 70fps+ worth of textures for the Voodoo 2, even though it is only 1x with no sidebands?

Christopher Bradford

Senior editor Andrew Sanchez replies: *Oh boy, the Voodoo 2/AGP dilemma. Well, according to 3Dfx, if your game is fill-rate intensive, then having that Voodoo 2 board in your AGP slot will speed things up thanks to the faster pipeline. The bad thing about the Voodoo 2 AGP is that you won't be able to use dual Voodoo 2, unless someone makes an AGP bridge chip, or more than one AGP port is engineered into a forthcoming core-logic AGPset (Intel, are you listening?). The final answer to your question is a big… don't know. Until we get our hands on both PCI and AGP Voodoo 2 and trash them in our benchmarks, everything is pure speculation.*

Quake II *uses the DirectDraw.dll. Did Carmack change his mind about* ***DirectX?***

PCI Latency Tip Redux

I recently bought your magazine for the first time and the plastic bag that it came in referred to a PCI latency timing tip on page 8 of some unspecified back issue. So, what was the tip?

Greg Donovan

Managing editor Sarah Pirch replies: *Back in* boot *10, we ran a letter from a reader who had overclocked his 166MHz CPU to 180MHz but experienced a reduction of his bus speed to 60MHz. Then-technical editor Chris Dunphy identified the problem as having to do with the fact that the PCI bus runs at half the speed of the system bus. So this reader's PCI bus was chugging along at a sluggish 30MHz and slowing down all his peripherals. A better solution is to leave the CPU at 166MHz and overclock the system bus to 83MHz—you'll see a noticeable speedup. Beware that fiddling with your system bus is the most extreme form of overclocking, and you risk melting not only your CPU, but also your RAM, motherboard chipset, and PCI cards; you'll also void your warranty. If you decide to do this, you must use an active cooling solution—one or more fans and a heatsink. Use the utmost care!*

Boy Seeks ATX To Accommodate Mommy

I constructed a modified version of your Dream Machine 97 but am faced with the problem of fitting it into a desktop case. I'm using the same motherboard you used and I was wondering if there are any large desktop ATX cases (two inner 3.5s, two outer 3.5s, two outer 5.25s) that will accommodate that motherboard. I've looked on the net and have come out empty-handed and slightly bewildered.

Dan Keller

Senior editor Andrew Sanchez replies: *The best place to start looking for ATX power cases is the official ATX formfactor web site at* **www.teleport.com/~atx/chas/index.htm**. *From here, you can take a peek at almost every ATX case vendor known under the sun.*

Calling Blunk on Scott Tarr

I have got to say that *boot* is by far the best mag for Technoweenies like myself. However, an issue without letters from reader Scott Tarr is just not an issue worth buying. Please include more Scott, even the online Comm Port has a missive from the omnipotent Scott Tarr.

Chris Blunk

Editor in chief Brad Dosland replies: *Does a letter about Scott Tarr count?*

Quakepocrisy

I noticed that when *Quake II* loads, it uses the DirectDraw.dll. Did Carmack change his mind about DirectX?

Ken Lang

id Software's John Carmack replies: *We have always used DirectDraw for displaying our software rendering, if it is available. It is not used in the OpenGL renderer.*

No Need For Speed

I don't need a 300MHz P-II with 64MB of RAM to play games! Do you really think anyone needs such a powerful machine? Don't you think you go a little overboard in terms of being power hungry? My Pentium 166MMX 32MB RAM with 3Dfx and ATI Xpert@Play runs Direct3D games and *GLQuake* really fast. And your predictions for 1998 said you should buy a 32x CD-ROM drive. Gimme a break! No software even takes advantage of 16x! Every time I read your magazine I get mad because I think my computer's a piece of crap.

Tyler Austin

Editor in chief Brad Dosland replies: *Your PC's not a piece of crap. If it satisfies you, then more power to ya! Enjoy. As for anyone needing a top-of-the-line system, many people demand the best. They want a steady 60fps—no dips—in the most strenuous new games. They want to crank all the options to the max. They want to multitask massive renders in the background while downloading 30MB files off the web and editing digital video in the foreground. These people are insane and should probably be institutionalized, but instead, we pump out a steaming new issue of* boot *for them every month.*

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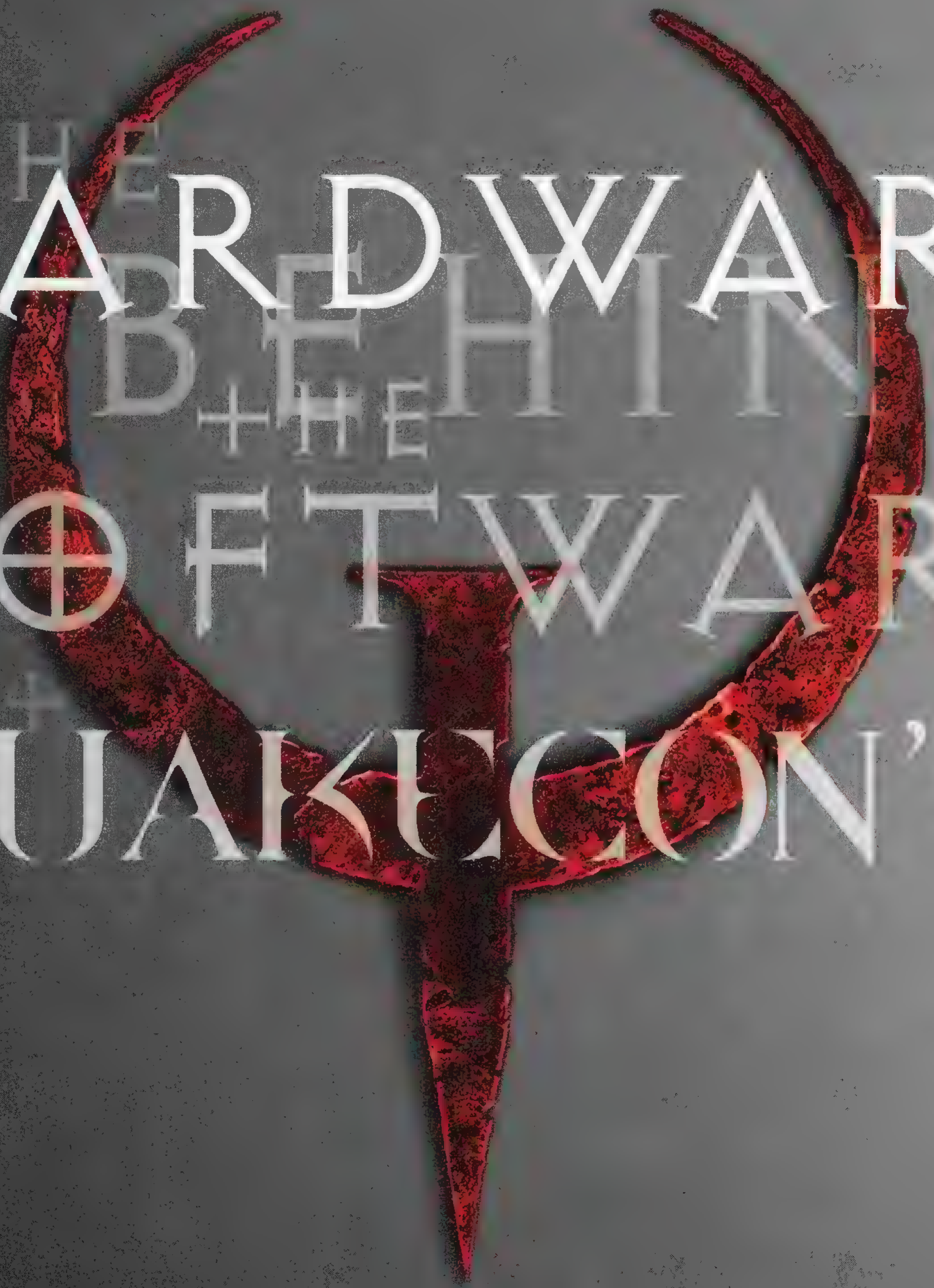
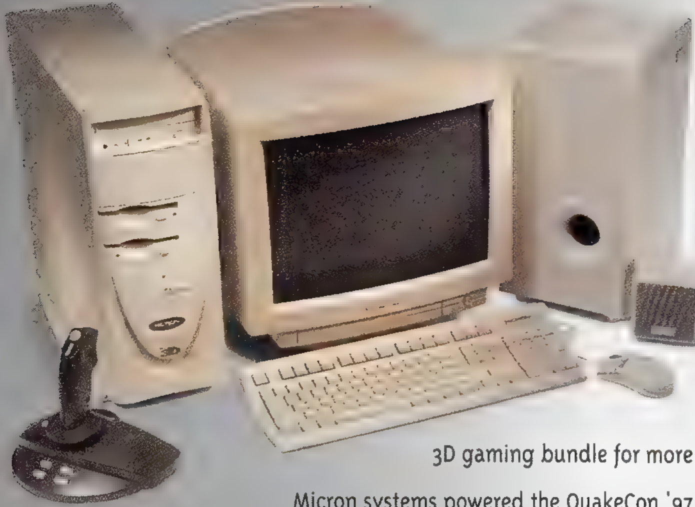
THE HARDWARE BEHIND THE SOFTWARE AT QUAKECON '97





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Micron systems powered the QuakeCon '97 competition. There, chief organizer Jim (H2H) Elson said: "Among the hard-core Quake fans on the Internet, it's long been established that Micron machines are peerless when it comes to performance and reliability."

Cyberathlete Dan (RIX) Hammans took first place at that QuakeCon '97, where Micron systems ruled. If you're serious about gaming, face real competition like RIX at www.cyberathlete.com. And if you're serious about computers, dare to call Micron or visit our Web site today.

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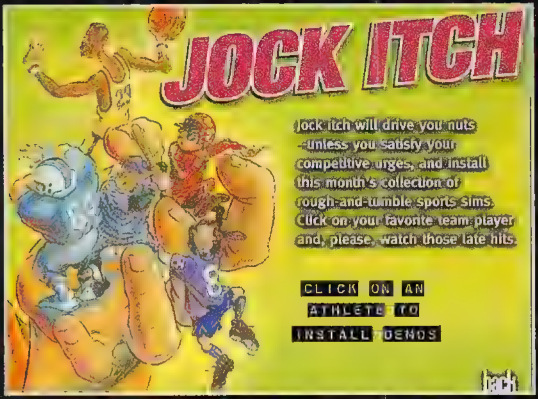
bootDISC

ON THIS MONTH'S DISC:

TRY IT ON THE DISC

EVERY MONTH, **BOOT** DELIVERS **OVER 600MB** OF THE **HOTTEST** DEMOS AND **COOLEST** APPS

Used to be that when the Superbowl was over, the Stanley Cup and NBA Final were still months off, the racetracks were still drying, and baseball was months away—there wasn't a whole lot to do, unless you owned a computer. *boot* sympathizes with true hardcore sports fanatics and has put together some of the best sports sims currently available. Just move your mouse over the corresponding professional athlete to sample the sports demos on this month's bootDisc.



Jock itch will drive you nuts -unless you satisfy your competitive urges, and install this month's collection of rough-and-tumble sports sims. Click on your favorite team player and, please, watch those late hits.

CLICK ON AN ATHLETE TO INSTALL DEMOS

SOFTWARE DEMOS:

3Dfx City Website *boot* brings you the first glimpse at 3Dfx City, 3Dfx Interactive's 3D extension to its web site. This early preview of 3Dfx City will give you a good idea of what the final city will look like once it is available for download from 3Dfx.

Andretti RACING

Andretti Racing Looking for a realistic Indy experience? Then check out *Andretti Racing*, designed with help from Mario, Michael, and Jeff Andretti. This game brings an accurate stock-car physics model to the PC with Direct3D graphics, virtual cockpit, and force-feedback support.

Precision Racing
TRIAL VERSION

CART Precision Racing Compete against CART cars in this white-knuckled race that takes you to speeds in excess of 200mph. The tracks in this game were re-created from GPS-based source data and are accurate within 10 centimeters of the real thing. And with Direct3D, the ride is all that much better.

DAYTONA USA DELUXE

Daytona USA Deluxe You're racing a Daytona stock car that's thundering down a straightaway at 250mph. Take a turn too low and your car flips, take it too high you'll eat the wall. This is *Daytona USA Deluxe*. Think fast! Features include six high-res courses and eight stock cars.

F1 Racing Simulation F1 Racing Simulation features the real drivers, the real cars and true-to-live renderings of all 16 circuits from the 1996 Grand Prix season along with the Official Formula One license from FOA / FOCA. Race on all 16 tracks from the 1996 F1 World Championship.

LapLink *LapLink* for Windows 95 is the remote-access solution for the on-the-go computing professional. Designed expressly for Windows 95, *LapLink*'s new 32-bit features provide you with everything you need to work effectively from the road, home, or the office.

Legends Football '98 *Legends of Football '98* includes 3D graphics with on-the-fly zooming effects and multiple camera angles, control that allows you to spin or dive to avoid defenders, over 1,300 1997-1998 NFL stars, and 1,000 legendary players with real-life attributes.

MADDEN NFL 98

Madden NFL 98 Experience the gridiron with the intensity that only John Madden can heighten. *Madden NFL 98* uses V-Poly technology for fast and fluid polygon-enhanced sprites. Play in 30 authentic 3D NFL stadiums with over 120 current and historic NFL teams.

NBA action 98

NBA Action 98 NBA Action 98 delivers full-court, 5-on-5 basketball in an intense, action-packed atmosphere. Features include all 29 NBA teams, over 340 NBA players, full team rosters from 1996-1997 season, smooth texture mapping and 10 different camera angles as well as Free-Cam.

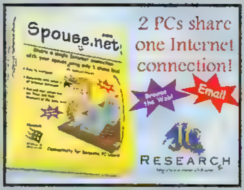
NHL 98 A brand-new engine provides smoother graphics and fast, fluid, NHL hockey that will get you off the bench. 3Dfx support, eight gameplay cameras, new player and goalie animation with 500 real NHL players' faces make this a truly realistic ice experience.

Remote DeskLINK

Remote DeskLINK Getting more work done used to mean spending more time at the office. Well, not anymore. *Remote DeskLink* for Windows 95 lets you leave the office when you want to and finish your work at home. It's one of the easiest ways to connect to your office PC from your home or another location, all at a price that puts remote control within easy reach.

SEGA WORLDWIDE SOCCER PC

Sega WorldWide Soccer Soccer fans—get ready. *Worldwide Soccer* is here with smooth 3D animations, 360-degree instant replay and on-the-fly commentary, and includes polygon-based characters and six modes of gameplay: exhibition, World League, World Cup, cup tournament, penalty shoot-out, and link game.



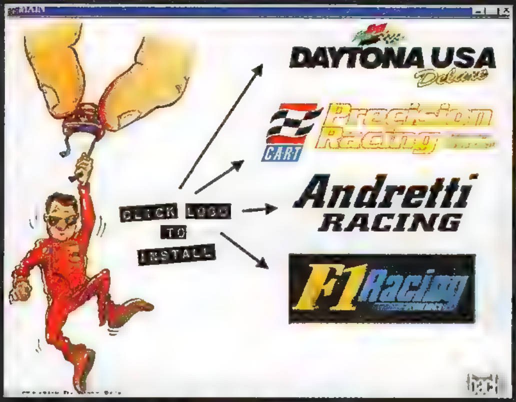
Spouse.Net *Spouse.Net*, the connectivity tool for the domestic PC user, allows two PCs to share a single Internet connection over one modem using a LAN network. Both PCs can browse the World Wide Web, manage separate e-mail accounts, download data, and use Newsgroups and Telnet.

Timbuktu Pro

Timbuktu Pro This powerful network remote-control software has an integrated remote node that's ideal for workgroups, remote workers, and help-desk administrators. Access corporate network resources, transfer files, and remotely control other computers over LAN, WAN, Internet, or dial-up lines.

TUROK DINOSAUR HUNTER

Turok: Dinosaur Hunter Prepare yourself for gut-wrenching gameplay and terrifying combat. *Turok* includes 14 high-tech weapons: the simple knife and Tek-Bow to a grenade launcher, pulse rifle, quad rocket launcher, and atomic fusion cannon. Are you ready for the primeval jungle?



Step into the cage that holds your machine, strap on the seatbelt, and get ready for balls-out speed. The racing sims in this month's Jock Itch sports feature offer a sample of different types of racing with different levels of realism and required skill. Not into racing? Check out the football, basketball, baseball, and soccer demos instead.

No CD? We Can Help

Fear not if you're holding a naked edition of *boot* with no *bootDisc* CD-ROM. You can subscribe to the full magazine/CD-ROM bundle, and even order individual copies of the *bootDisc*, by calling customer service at 800.274.3421. Each month, the *bootDisc* is stuffed with game demos, application demos, utilities, and patches–so don't miss this treasure trove of valuable software.

FIFA Road to World Cup 98 Conquer fierce defenders and defeat entire nations on your quest to qualify for World Cup 98. Includes "one-touch" passing for player and ball control, motion captured players and moves, and a new 40,000 word play-by-play and color commentary and script.

G-Police You solve a murder mystery while serving as pilot for the G-Police, patrol the skies of the domed cities of Callisto, and enforce law using 1000kg bombs, industrial lasers, and hyper-velocity missiles. Features include outrageous support for 3D-accelerator cards.

NHL PowerPlay 98 From fake shots, stumble passes and one-timers to dump-ins, deflections and hooking, *NHL PowerPlay 98* delivers accurate skating physics for realistic controls. Other features include new AI with over 650 NHLPA players and all 26 NHL teams performing true-to-life.

PC Anywhere 32 Connect to your office PC, whether you're at home or on the road. Now you can remotely control your office PC via modem or the Internet. Quickly synchronize files between two computers. It uses optimal 32-bit support for both Windows 95 and Windows NT.

VR Baseball Imagine being able to play Major League Baseball from any position or angle you choose. You'd better have a 3D graphics card because VR Baseball is the next generation of PC baseball games and works only with hardware-accelerated systems.

Wing Commander Prophecy A new space combat engine, a terrifying new alien menace conceptualized by renowned artist Syd Mead, and a new story begins the next chapter in the *Wing Commander* series. 3Dfx support for speed and special effects enhancements make this the ultimate sequel.

VIDEO DRIVER MADNESS

[illegible] it, you'll find all the newest drivers for all the newest and hottest cards. Unfortunately, there's no easy way to get your current video driver version, although some manufacturers list it in their section of the Display Properties in the Control Panel. [illegible] what you're getting yourself into.

MANUFACTURER	VIDEO	WIN 95	WIN NT 4.0
3Dfx	Glide Drivers	2.43	—
ATI	3D Rage Pro Cards	[illegible]	[illegible]
	3D Rage II Cards	4.10.2278	4.3.92
	3D Rage I Cards	4.03.2139	3.1.76
Canopus	Pure3D	1.30.04	1.10.03
	Total 3D	2.10.04	2.20.06
Creative Labs	3D Blaster (Revision 3)	3DBP-95DRV-1-US (Revision 3)	3DBP-NTDRV-1-US
Deltron	Flash 3D	1.2	—
	Flash AT3D Rush	1.2	—
Diamond	Monster 3D	1.09	—
	Stealth II S220	4.10.01.0101	4.00.1381.0101
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	
Hercules	Stingray 128/3D	[illegible]	
	Terminator 3D	[illegible]	
Intergraph	Intense 3D	[illegible]	[illegible]
Jazz	Adrenaline Rush	2.06RB	—
Matrox	M3D	1.0	—
	Millennium & Mystique	3.80.007	3.30
Number Nine	Imagine 128 Series 2	4.16	4.102.30
	Revolution 3D	1.42	4.103.28
nVidia	Miniport GL Driver for Riva 128 ICD	Alpha-2	—
Orchid	Righteous 3D	3.0	—
PowerVR	MiniportGL Driver	1.0	—
Rendition	V1000 MiniPort GL Driver	Beta 2	—
	V2x00 MiniPort GL Driver	Unofficial Release	—
STB	Lightspeed 128	[illegible]	1.0
	Velocity 128	3.00U	1.0
VideoLogic	Apocalypse 3D	[illegible]	—
	Apocalypse 3Dx	4.1.0	—
	Apocalypse 5D	4.3.4	—

Microsoft and SGI Team Up to Deliver Yet Another API Manufacturers Can Develop Broken Drivers For

Fahrenheit

As reported in *boot* 18, Microsoft announced it was formally pledging support for OpenGL development, but only for high-end applications. "Direct3D and not OpenGL," Microsoft pundits claimed, "was still the API of choice for games."

About a week after we went to print with that bombshell, Microsoft and SGI lobbed another incendiary on the development world in announcing a strategic alliance that aims to "define the future of graphics technologies."

So what will the future hold? For starters, nothing from the metric system. The new project, strangely entitled the Fahrenheit Project, is really nothing more than a glamorized new set of development APIs for use with Windows and Unix-based operating systems. Fahrenheit will incorporate all facets of Direct3D, DirectDraw, OpenGL, OpenGL Scene Graph, and OpenGL Optimizer for a full-featured, tri-leveled API. The low-level portion will become the primary graphics API for both consumer and professional applications on Windows-based platforms, with the Scene Graph API and the Large Model Visualization Extension more suited for high-end, graphics-rich applications, and SGI's IRIX operating system.

But if you think this spells an end to DirectX, think again. The low-level API, which will be backward compatible with D3D—but only functionally compatible with OpenGL—isn't expected until sometime in the year 2000.

ATI Buys Assets from Tseng Labs

Tseng Labs has announced the sale of its graphics design assets to ATI Technologies. Included in the sale to ATI are equipment, tools, and certain rights to intellectual property. Approximately 40 members of Tseng's 3D graphics development team, including engineering and marketing personnel, have accepted an offer of employment with ATI's U.S. subsidiary, ATI Research Inc.

Tseng Labs will continue to support its current products and is in discussion with various entities regarding ongoing rights to these products.

"Tseng has weathered a difficult time, but we believe we have found a positive resolution that benefits our shareholders," said Jack Gibbons, president and CEO of Tseng Labs. "The substantial earnings to be derived from these cash assets together with the cash flow from the lease of our facility to ATI will fully support Tseng's acquisition strategy and eliminates the need to utilize the company's working capital."

The deal will cost ATI $3 million.

However, as the 3D-accelerator war continues to rage at an astonishing rate, ATI's acquisition may signal a redoubled effort on its part to speed up video processor development. With its Rage 4 already well into development, ATI may have decided to have the Rage 5 spec'ed out and started on by the Tseng Labs team, in an effort to parallel development of its next-gen product.

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nVidia Update

A boot SPECIAL REPORT

Recently, *boot* has been bombarded with letters about our reviews of nVidia's Riva 128 chipset. Many loyal readers have turned and complained that our criticism of the chipset's sacrifice of visual quality for speed (which we described as "pushes the speed limits of what we've seen") was unduly harsh. Bear in mind that all three cards—from STB (reviewed in *boot* 16), Diamond (*boot* 16), and Canopus (*boot* 17)—scored a bootVerdict of 8 on a scale where no video card has ever picked up a coveted 10. We knocked one point off the verdict for the visual-quality issues. We knocked the second point off for substandard TV output specific to the card manufacturer's implementation.

boot's
nVidia
Riva 128
update

Many readers also took us to task for not updating the video drivers during our review of Gateway's G6-233 system (*boot* 17). It is *boot*'s policy to review systems as they are shipped. Updating drivers or tweaking the system to coax additional performance isn't allowed, except in cases of absolute necessity (e.g., the system doesn't work at all). In this specific case, however, Gateway shipped first-revision drivers with its machine (a fact verified by nVidia), and newer drivers—fixing the noted transparency problems—weren't officially released by STB until after the review was completed and submitted. Remember, *boot* works with a three-month lead time.

"The Riva 128 is a milestone product for the PC industry and the first mainstream chip to deliver over one million 3D polygons per second, as well as outstanding 2D, video, VGA, and high-speed RAMDAC in a single chip," said nVidia's Michael Hara. "3D graphics is the most dynamic and exciting technology to hit the PC since its inception, and we [nVidia] have always appreciated *boot* for its frank and factual perspective and analysis."

boot recently met with nVidia to discuss its next-generation technologies, and more importantly, recent strides in driver development. Both nVidia and *boot* agree that driver maturity issues are part of a 3D accelerator's natural growing pains, and to its credit, nVidia has made drastic improvements. Many of the problems we initially encountered—such as weird palette shifts in *Incoming*, graphical glitches in *Moto Racer*, and the missing transparencies of *Jedi Knight*—have now largely been fixed.

But the visual fidelity issue hasn't been fixed—and won't be—until nVidia introduces its next-gen product. The Riva 128, like all 3D accelerators including Rendition's V2000 and 3Dfx's Voodoo, employs a dithering algorithm to dumb down texture palettes to a lower color count. In the Riva's case, the dithering algorithm results in a very spotty or speckled effect on textures, noticeable in almost any accelerated game, ranging from Rage's *Incoming*, to id Software's *Quake II*. This is something *boot* has noticed in almost every 3D accelerator in one form or another, but in the Riva's case, it is readily apparent when compared with the almost spotless dithering done by other processors.

Yes, the Riva 128 is a fast-as-lightning 3D processor capable of locking down almost arcade-quality frame rates. And its overall performance is head-and-shoulders above most all-in-one solutions. But, the chip isn't perfect—and visual problems do exist—whether you're willing to admit it or not.

Look for the first preview of nVidia's next-gen chip and an exclusive, no-holds-barred Lip interview with nVidia's technical geniuses in an upcoming issue of *boot*. b

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Japanese Coalition Develops Way to Shrink Chips

A coalition consisting of Kyoto University, Fujitsu Laboratories, and Japan Science and Technology Corp. has developed a new process that allows chip makers to cut smaller and smaller grooves into the silicon wafers that are used to produce chips (a process known as doping).

The current doping process yields 0.25 microns. But the new process—known as cluster ion-beam implantation—will allow semiconductor manufacturers to cut grooves, or trenches, that are a mere .05 microns in size into silicon wafers.

The coalition indicated that the technology would be available within four years and could be the cornerstone of a series of technology advances that would reduce chip sizes by almost 300% while increasing the performance of some semiconductors by as much as 64x.

Panasonic Develops Single Chip DTV Silicon

Panasonic AVC American Laboratories—the North American digital-TV research facility of Matsushita Electric Industrial—has developed a single-chip DTV video decoder chip targeted for HDTVs, converter boxes, and DTV add-in cards for the PC. The hard-wired silicon is the industry's first single-chip device that can decode and display ATSC-specified DTV signals in native video formats or in down-converted formats.

The work normally performed by two video-decoder ASICs and one display processor can now be completed by a single HDTV chip, but Panasonic's chip goes one step further by simultaneously offering a down-conversion capability to translate all ATSC-specified video formats into 480i and 480p, while the Mitsubishi/Lucent chipset displays video only in 1080i and 720p for HDTV receivers.

The chip decodes any MPEG-2 video bit streams, including MPEG-2 video Main-Profile @ High-Level. The same chip also acts as a video display processor and can display images in various raster formats, including 1080i, 720p, 480i, and 480p.

The single-chip digital-TV video decoder uses a 0.35-micron process. Per-chip pricing is expected to be less than $100, or twice as much as current MPEG-2 decoders.

The chip made its first public appearance at the winter Consumer Electronics Show in Panasonic's new set-top box.

IBM Breakthrough Doubles Hard Disk Capacity

IBM researchers have once again broken their own record for cramming data onto hard drive platters. Their previous record of five billion bits (5GB) of data on

17 >

The **Death** Of The **High-End** PC

SUB-$1,000 OR GO FOR **BROKE**

If you've ventured into your local computer store recently looking for a *boot*-caliber, high-end computer system, you may have discovered an alarming trend.

There aren't any.

POWERPLAYER
1996-1997
R.I.P.

Oh sure, there may be a couple of machines masquerading as such, but the truth is, many manufacturers, including such industry heavyweights as Toshiba and NEC, no longer view the high-end PC as a profit-inducing, shareholder-increasing viable market. Thus, the high-end dream machine has become an endangered species.

The culprit? Unprecedented consumer demand for low-end machines—the infamous sub-$1,000 PC. This burgeoning product category accounted for less than 4% of the market a year ago, but today, thanks in part to dipping processor prices from Intel, AMD, and even Cyrix, these popular PCs (according to National Semiconductor), are poised to command upwards of 40% of the entire market. As a result, most, if not all computer manufacturers have jumped on this budget bandwagon in the hopes of rekindling some of their dwindling profit margins and end-unit sales.

> "**Impressive sell-through** [of our low-end systems] is causing us to **revise our expectations** as to how well our high-end systems will do throughout 1998."
>
> —*Compaq's Alex Gruzer*

"The overall incremental growth of our business", said Alex Gruzen, Compaq's director of Desktop Marketing, "is being fueled by the demand and growth of lower-cost PCs."

In fact, according to market-research firm Computer Intelligence, Compaq's $799 Cyrix-based Presario 2200 series was the fourth-most popular Compaq model sold last November, accounting for almost 10% of all Compaq sales. "Almost 40% of our computers sold last year were to first-time buyers, who were attracted not only to the low price, but also to the compelling features," said Gruzen, citing such components as AMD's K6 processor, 3GB hard drives, and 20x CD-ROMs (all of which can be found in Compaq's new $799 Presario 2240).

And despite the cancellation of the company's 7000/8000 high-end series (which has been replaced by the 4800 series), Gruzen insists that Compaq has no plans to exit the high-end market, as did competitors Toshiba and NEC, who eliminated their high-end lines late last year.

"We were pleasantly surprised at the strong demand for our 300MHz Pentium II machines during the Christmas season," says Gruzen, "and this impressive sell-through is causing us to revise our expectations as to how well our high-end systems will do throughout 1998."

Unfortunately, Toshiba's future prospects aren't anywhere near as rosy. Declining unit sales and profit margins forced the company to abandon its high-end Infinia line in America, as the company found itself woefully unprepared for the sub-$1000 explosion.

INFINIA
1996-1997
R.I.P.

"The market has radically shifted during the past year," says Van Andrews, Toshiba's vice president and general manager, "and our [Toshiba's]

Toshiba's Infinia PC line, featuring a cool monitor-mounted LCD display is now history. May it rest in peace.

business strategy was to focus on the higher-end consumer that valued seamless integration of multimedia, not the sub-$1,000 segment."

Still, Toshiba isn't out of the PC consumer space completely. According to Andrews, "the company is currently evaluating all facets of the home PC arena and plans to re-enter the market with a compelling product—sometime in 1999."

So where does this leave aggressive price competitors Cyrix and AMD? Well, Cyrix's MediaGX processor has found a happy home in Compaq's low-end desktop and sub-$2,000 notebook lines and is currently being showcased in a reference design called the Cyrix Media Center, a sub-$1000 TV-set-top box that includes a motherboard implementation of NEC/VideoLogic's PowerVR 3D accelerator. And even though AMD met its goal of shipping 1.5 million K6 chips last quarter and is doing well in machines from Compaq, IBM, and Acer, many see AMD forever languishing in the low-end market, irrespective even of its forthcoming, highly anticipated K6+3D.

"The **market has radically shifted** during the past year, and our business strategy was to focus on the higher-end consumer."

—Toshiba VP Van Andrews

"If you look at the offerings from AMD or Cyrix today," says Compaq's Gruzen, "the performance equation puts them, for us, in a $999 or a $1,299 system." And even though companies may ultimately not be religious about what (or who) is actually inside the PC, he notes that "Intel has great performing products that naturally fit into that [high-end] space."

But after its market share dropped almost 8% during the last quarter of 1997, Intel can't afford to be complacent. The company was severely aggressive in its pricing last year, and that trend is expected to continue well into 1998. And with good reason too—Intel won't be introducing as many new processors as it did last year, and the company was late in acknowledging the existence of the sub-$1000 market. And with all those new Socket 7 chips from Cyrix, AMD, and Centaur/IDT hitting the streets this year, Intel's Slot 1/Pentium II combo may not be that attractive to system OEMs hoping to capitalize on the first-time or incremental buyer. In fact, Pentium II's accounted for less than 20% of Intel's sales this past fall (in comparison, run-of-the-mill Pentiums with MMX represented more than 60%). As such, its stranglehold on OEMs may loosen this year.

COMPAQ
7000/8000
1996-1997
R.I.P.

Finally, if you thought the sub-$1,000 PC was a bad idea—it gets worse. The dumbest of them all—the moronic WebTV—underwent a minor facelift late last year, and guess what? Consumers gobbled them up in large numbers. Scary.

NUGGETS

> 16

a single square inch of disk drive space was shattered with the announcement that it has successfully doubled that to 11 billion bits of data per square inch. "With this laboratory demonstration, we're on track to provide products with 10GB density by the year 2001," said Robert Scranton, IBM Storage Systems division vice president.

The demonstration yielded data rates of 14 million bytes per second with an almost flawless on-track data read. (IBM conjectures that with data correction codes, errors would be reduced to less than one in a trillion bits read). These leaps in technology can be accredited to IBM's earlier invention of the magnetoresisitive (MR) sensor for reading data on hard disks in 1991. It's this MR sensor that allowed hard drive manufacturers to increase data density leading to drives that are smaller and lighter, consume less energy, and deliver faster reliable data all for mere pennies per megabyte.

So when will you see these new behemoths? IBM officials said they expect the new density to become available on the market within four years. More importantly, IBM surmises that the average storage costs (currently at $.10/MB, down from a staggering $5.23/MB in 1991) would be cut by more than two-thirds in the process. Or in other words, that 100GB hard drive you'll be eyeing in the year 2002 may set you back only 300 greenbacks!

Intel's Merced Sees the Sun

In a move that should make the lads from Redmond nervous, Intel and Sun Microsystems have announced a deal that'll bring Sun's Solaris operating system to Intel's IA-64 processor (a.k.a. Merced), making Solaris—a flavor of Unix—a bonafide alternative to Windows NT 4.0. (Version 5.0 is expected sometime in mid-1998.)

Solaris and Merced will ship sometime in 1999. Pricing, as usual, is yet to be determined.

California Graphics Joins Voodoo 2 Bandwagon

CALIFORNIA GRAPHICS & PERIPHERALS, INC.

Joining the growing Voodoo 2 rank and file (which already includes such industry heavyweights as Creative Labs, Guillemot, Jazz Multimedia, and Diamond) is California Graphics' new Wizard 3D. However, one thing sets the Wizard 3D apart from the rest of the pack—it's the first Voodoo 2 board to include TV-out ports.

The Wizard 3D will come equipped with a bunch o' memory—12MB to be exact—with one 4MB pixelFX2 chip and two 4MB texelFX2 chips. And like with all other Voodoo 2 parts, you'll be able to harness even more power by adding another card to activate ScanLine Interleave mode, bringing the total local video memory to a whopping 24MB.

A PCI part will be introduced first (in Q1/98), with an AGP 1x/DMA part promised later in the year. Expect the retail price of the Wizard 3D to fall somewhere around $299.

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Product Information Number 13

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The $129 watch weighs only 1.3 ounces, and with a quick button press, it can be detached from the wristband and worn in an optional holster. Beepwear can hold up to 16 messages in memory and includes an Indiglo nightlight alerting you to any incoming pages. Other features include forward and reverse scrolling, dual time zone displays, stopwatch functions, time/date stamping, and ten alarms or reminders.

Beepwear incorporates Motorola's powerful 900MHz Flex technology to offer improved page reliability and Timex's legendary reputation for timekeeping accuracy and durability. Service agreements start at $8/month, and you can even request three free information services including news, sports, and entertainment headlines. MTX Paging Products; www.beepwear.com

WOODTECH PC *Let's face it, the typical beige PC does nothing for the décor of a room. You've invested in a genuine faux leather chair, so go the whole mile and invest in the "Rolls Royce" of personal computers, sporting the distinctive Woodtech case. These hand-crafted systems come in your choice of genuine oak, cherry, walnut, or mahogany. And don't stop at the PC case: Tree skins are also available for your monitor, keyboard, mouse, and mousepad, for that rich warm look that just screams "old money." With price tags ranging from $7,500 to $14,000, this luxury doesn't come cheap, but Woodtech doesn't skimp on the silicon that goes under the lumber. Pentium II processors running up to 300MHz burn with 64MB SDRAM, a 24x CD-ROM, an 8GB HD, and a 19-inch monitor. And while wood cables are not currently available, wireless mice and keyboards are. Woodtech; 435.723.2355; www.brigham.net/~woodtech*

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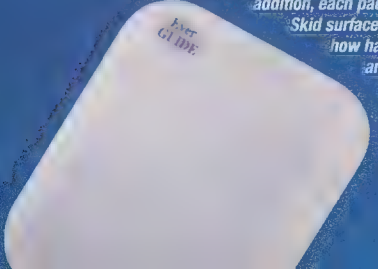

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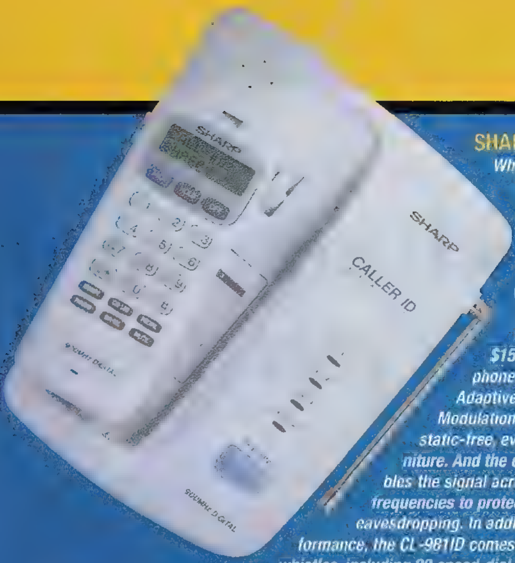

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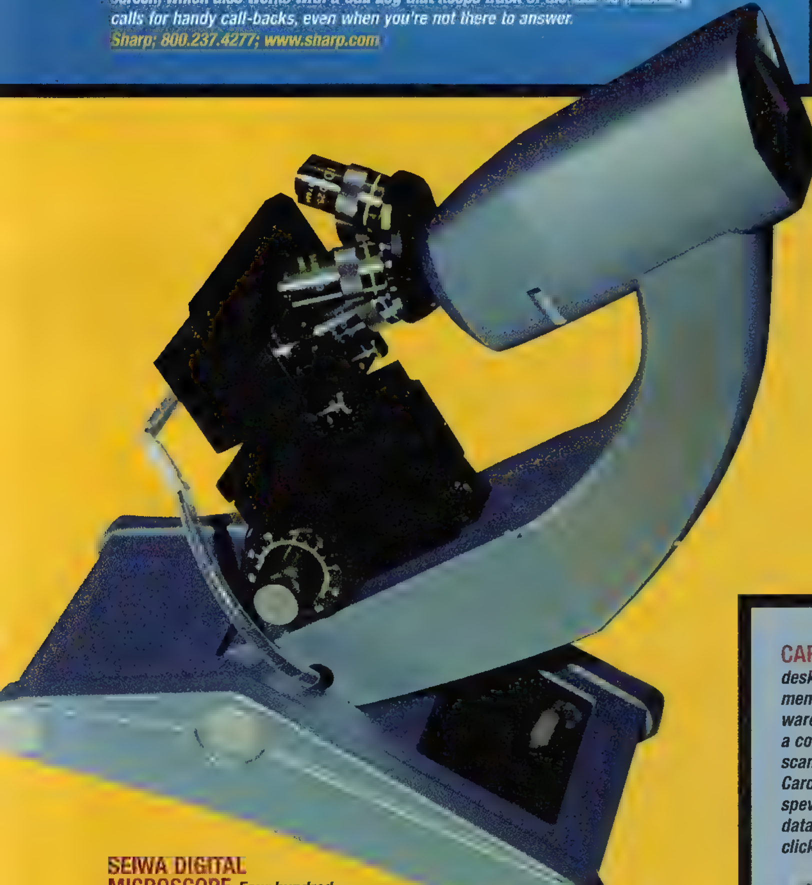

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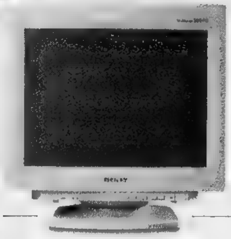

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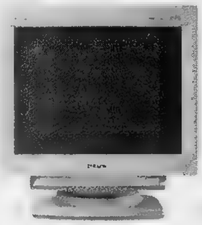

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THE SAINT

WITH ALEX ST. JOHN

The **Truth** About **OpenGL**

OGL CANNOT SAVE YOU FROM THE **LIMITATIONS** OF YOUR OWN **OS**

Drivers are always broken. I'm not going to devote another column to explaining why. But as a guy who spent almost five years at Microsoft up to his elbows in driver issues, I'm telling you beyond any shadow of a doubt that it's true. Betcha didn't know I was originally hired as Microsoft's publishing evangelist to try to bring Windows up to par with the Macintosh in printing technology. You know what the major obstacle was? Drivers. The damn things are always broken. The slightest change in the OS, the blink of a DDK, the addition of a little feature, a new generation of hardware with slightly different performance characteristics—and BLAM! The drivers go to hell and nothing works again.

What's this have to do with OpenGL vs. Direct3D? It's actually what the real debate is all about. Microsoft can't make even one 3D driver architecture work. In fact, none of its multimedia driver architectures really work.

D3D evolved on Win95 because Win95 was designed to be a consumer OS. Microsoft expects gamers to play on Win95. WinNT is the server and workstation OS, and that's where OGL evolved. What's the difference? Not the API, but the implementation. Demanding OGL is as clear a specification as saying, "I want a car!" Really? Would that be a Yugo or a Ferrari? They both have four wheels and an engine. Simply saying "OGL" doesn't imply a driver model. What happens when folks such as ATI and nVidia, who never manage to make a working driver—even when they are supplied with a DDK, sample code, and a testing procedure—take it upon themselves to make up their own OGL drivers? BOOM! That's what.

> My dark secret is that **DirectX** was originally formulated as a perpendicular strategy to knock **Apple** out of multimedia. The fact that it was useful to DOS **game developers** was incidental.

So why position OGL as a high-end solution? Because in the high-end, 3D cards cost a few thousand dollars, and only a handful are sold. Sure, they all have home-grown, custom-tweaked (but still busted) drivers. But it's not a big deal when they blow up because not many people have them. The few who do have them pay for massive support contracts. What happens if you lose that quality of product in the consumer space? Several million angry support calls.

Many of D3D's limitations, such as lack of extensibility, are intentional, designed to limit the opportunities IHVs have to screw up the drivers. Many of the other problems with the D3D API are associated with flaws in the OS itself. The seemingly unnecessary complexity of page locking DirectDraw surfaces is a "feature" of backward compatibility with Win16 applications. Most of the performance difference between 3Dfx's D3D driver and 3Dfx's Glide driver can be attributed to the fact that Glide doesn't bother to be reentrant, so it can crash at any time. Whoops! But that's the kind of thing IHVs conveniently overlook when they roll their own "amazingly fast" drivers.

Microsoft doesn't have an OGL driver model suitable for mass deployment. If it ever made one, the driver would either suffer from the same limitations as D3D or it would be forced to hide them with a slow abstraction level.

This is a very practical problem of trying to support OGL for games, and you can see this clearly reflected in Microsoft's recent OGL announcement. Paired with a reiteration of its positioning of OGL as a high-end API, is a commitment to attempt a new DDK for it along with a certification process. Sounds like a step in the right direction.

But it also means parallel 3D driver models for every card and another driver to write for those IHVs that can't even make one work. Most developers know how bad their driver problems are but have no idea how they get that way or whose fault it is. They don't understand that the 3D API isn't the problem. It's the driver model. And demanding a change in the API only worsens the problem. The purity and performance of an elegant API is corrupted by a limiting OS and by IHVs competing to one-up each other in performance and features, without consideration for stability. These forces result in a "horribly broken API," to quote John Carmack, no matter what you start with. (This is one of the reasons I think Java is such a fantasy. It walks right into this beauty-and-the-beast trap of technical purity vs. the market forces of corruption.)

ALEX ST. JOHN From his position as Microsoft's game technology evangelist, Alex St. John was responsible for the controversial DirectX APIs that have either taken PC gaming to the next level or were horribly broken, depending on your point of view.

Back when I was hired at Microsoft, Bill wanted to eat Apple's lunch something fierce. We had people going after Apple's developers and its OpenDoc initiative, and teams of engineers devoted to beating QuickTime. The lawsuits were flying; it was almost as much fun as competing with Netscape today.

And that's the point. Microsoft is driven by its competition. My dark secret is that DirectX was originally formulated as a perpendicular strategy to knock Apple out of multimedia. The fact that it was useful to DOS game developers was incidental. If DirectX hadn't been a thorn in Apple's side, we'd never have gotten to make it. Support for OGL and the acquisition of SoftImage was part of a grander strategy to set NT up to take SGI's market. I know Microsoft will only focus on targeting OGL at the high-end because I know why Microsoft supports OGL to begin with. The day Microsoft encounters a major competitor whose strength arises from the community of game developers is the day game developers will get Microsoft's full, undivided support and attention. Don't forget that. ▮

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Product Information Number 261

GAME THEORY

WITH T. LIAM McDONALD

Caveat **Deluxe** Pro

MULTIPLAYER SUPPORT AND 3D **ACCELERATION**

Last month's whinge was about publishers being held accountable for the way they portray the features of their games (i.e., they tend to lie). That was a relatively bug-free column, so instead of offering a "patch" with some fixes, I'll just go ahead and do a full-blown sequel. Nowadays, you can call almost anything a sequel, even a glorified level pack such as *Tomb Raider II* or a lame rehash such as *F-22 Raptor*.

Which brings us to the point. To wit: You are being ripped off in dozens of little ways. It's like the death of a thousand cuts. Alone each cut is small, but collectively they whittle away at the respectability of computer games, contributing to a loss in consumer confidence that could kill this industry in its adolescence. As with most problems in a free market, the two bugaboos are greed and incompetence. Neither is fatal on its own, but together they form a deadly brew.

The problems are all part of the same cluster—incomplete products. This is manifested in many ways: buggy games; games released without promised or crucial features; and "enhanced" games, which are usually, but not always, a rip-off.

"Buggy software" is a redundant term. All new PC software has some bug at some level. This is known and accepted. What is not accepted are those bugs that are so clear and so egregious as to make even a novice wonder how they got through QA. *Patriot*, *Falcon 3.0*, *Daggerfall*, and *Battlecruiser* became legends because they were released in what essentially was an alpha state. *A-10 Cuba* had the rudders reversed. *Front Page Sports Football 98* had disappearing players, screwed-up kickoffs, and countless other problems (and this for a fifth-gen iteration of a gaming system). *ABC Monday Night Football* required a double install to run. *A-10* and *Civil War Generals II* wouldn't even run on many systems.

You are being **ripped off** in dozens of little ways. It's like the **death** of a thousand cuts. Alone each cut is small, but collectively they whittle away at the **respectability of computer games**.

Do they miss these bugs in testing? No, they simply opt for the bottom line over consumer satisfaction, and who gets screwed?

You do.

Bugs have always been a problem, but the blight of outright missing features has reached epic proportions only recently. The most common casualties are multiplayer support and 3D acceleration. Sometimes multiplayer features are added in patches, put into upgrade packs, or, in games such as Skynet, turned into entirely new games. Few games ship with stable multiplayer support, but many promise it in the feature set and then don't even attempt to put it into the finished package (à la *Jetfighter III*). Why? Because it's expensive, time-consuming, and tricky to execute, and requires tons of expensive tech support. So it's dangled in front of gamers to get them excited and then snatched away at the last moment.

3D cards have become ubiquitous enough so that any game released from winter of 1997 on should have support out of the box. Of course, this has not been the case, resulting in two types of consumer hosing: the patch and the "deluxe" version. It's annoying enough to have to wait three to four months to download a very large 3D patch that should have been in the game to start with. Far worse is having that patch put into a "deluxe" version and then being charged full price after buying the non-deluxe version. Was there really any other reason for *Need for Speed II SE* aside from the 3D patch? Or *MechWarrior 2: Mercenaries 3Dfx*?

Sega even had the unmitigated gall to produce and ship the über-lame *Daytona Deluxe* with a line on the box saying "D3D support coming soon online!" First, if they knew well enough in advance to print it on the box, why didn't they hold the product until it was ready? Second, why make consumers jump through hoops to get what they deserve when they pay $40 for the game? Third, where is the frigging patch three months later?

And who gets screwed?

You do.

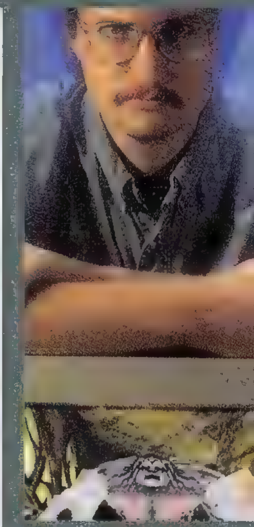
Last but far from least are those games that are so feature-crippled or so behind the curve that one wonders if the developers simply dozed off, woke up, and wrote "ship" on the nearest disk at hand. Why did *Dungeon Keeper* come out with a fatal AI bug? Why did *iF-16* and *MS Flight Sim 98* clock about 10fps? Why did *D-Day: America Invades* have no installation routine? *Test Drive 4* no dashboard speedometer? *Age of Empires* no unit AI? *Streets of SimCity* no entertaining elements whatsoever? And for the love of God why does Lara Croft continue to vanish into walls up to her scantily clad ass?

The fact is that both developers and publishers know the solutions to every single one of these problems. They simply do not care.

Fixing frame rates, preventing clipping, creating a decent AI, adding multiplayer support or 3D acceleration: these are all things we know how to do. Some developers even do it right. But it takes time, testing, and skill. Some programmers may indeed lack these skills and should be canned. But it's more likely they're not given enough time to do the job right. Far too often, marketing departments are determining when a game should be released and how it should be represented, regardless of whether that game is done and whether that representation is accurate.

And who winds up taking it in the shorts?

I think you know who... ▮



T. LIAM MCDONALD is the all-knowing god of gaming. His mother still can't believe that he plays games for a living.

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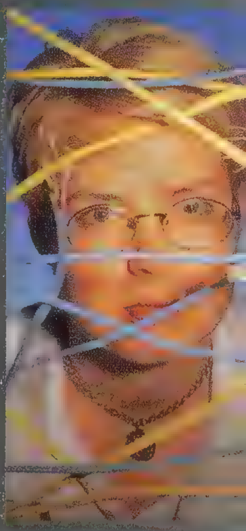

SHEL KIMEN is traveling the world (real time, not virtually), so e-mail response may be slower. But as always, try her at kimen@well.com.

Not-So-Free **Speech**

PAYING THE PRICE FOR "**FREE**" E-MAIL

Speaking of the evil empire, Microsoft recently announced its acquisition of Hotmail, the free e-mail service, which is now Hotmail, a wholly owned subsidiary of Microsoft.

I find it especially interesting that the announcement was made the last week in December, with minimum news coverage.

Hotmail generates revenue from advertising banners. Users fill out a "confidential" profile used to help advertisers target appropriate customers. Hotmail guarantees in its Terms of Agreement that user name and identification is not given to third parties; however, how much of this will change with its new owner? Hotmail also has a user directory in which any other users can get information about your likes and dislikes, as well as your real name and location. This service is a clearly marked option in the sign-up process. But when I encountered an error during sign-up and had to go back and fill in an incomplete section, it reset this option—and only this option. If I hadn't noticed, I would've been added to the directory against my will. It's "accidental" glitches like this that hurt the end user.

For the sake of comparison, I investigated a few other "free" e-mail programs: Yahoo, Lycos, Excite, and Juno. These are among dozens of services that offer free e-mail in exchange for demographic information. Word to the wise: Read the Terms of Agreement closely. The little box labeled "Agree" or "Disagree" can be extremely important.

> Juno requires your **consent** to use your name and user **ID**. There's a **catch**, though. If you miss a **checkbox** in the registration process, then you ain't **protected**.

Yahoo discloses information only to its partners, so I did some research on Yahoo's partners. Besides the obvious affiliation with Ziff-Davis (the publishing monstrosity under the Softbank aegis—expect regular pitches for Seybold Seminars and *PC Magazine*), you'll also find Intel, Compaq, Sequoia Capital, Reuters, I/PRO, TIBCO, and Global Center on the Yahoo list.

If you look at the clients and partners of those corporations, the family tree gets daunting. Off the I/PRO arm you get American Express, Allstate Insurance, NBC, Playboy, Prodigy, Hotmail (!!!), NetGravity (advertisement management software), Neilsen Media Research, CondéNast, USA Today, Warner Brothers New Media, *National Geographic*, *Forbes*, Turner Broadcasting Systems, Hearst, Time Inc., and Johnson and Johnson. Dangling off the TIBCO branch, you'll find half a dozen banks in the United States and Canada, Chevron, and Motorola. Global Center connects you to Intel, iCat, Microsoft, Pitney Bowes, SGI, Sun, 3COM, and Cisco, which connects you to Bell Atlantic, GTE, British Telecom, Ericsson, GE Capital, and Hewlett-Packard. And this is an incomplete list! Potentially every aspect of our consuming life—from banking to insurance to telecommunications to toothpaste—can be touched by the information on your Yahoo "free" e-mail account.

While **Lycos** doesn't have the corporate-networking clout of Yahoo, it does encourage you to try one of its commercial e-mail accounts before doling out the free one. For $14.95 you can get a cool vanity domain like Doctor.com or Worshipper.com or even 2die4.com (sheesh!). And for $23.95 you can get POP access (which sort of defeats the point of web-based e-mail now, doesn't it?). While Lycos promises not to monitor your e-mail, it says nothing about what it will do with your profile information. You're required to add your street address and daytime phone number—even for free-access accounts, but Lycos makes no statement about the protection of this information.

Excite mail offers the most user protection by stating that the company needs approval in writing to distribute your personal information to third parties. It does not, however, specify whether "in writing" signifies postal or electronic mail. Excite is also the only service of the five I looked at that guaranteed in its Terms of Agreement not to "edit" or "censor" user's e-mail, in addition to a no-monitoring policy.

Juno has been offering free e-mail for a long time, though it doesn't offer a web-based interface. Juno claims the right to monitor mail going through its public mailing lists if it deems it necessary (!?). And it requires your consent to use your name and user ID. There's a catch, though: "Such consent shall be presumed if Juno provides (electronic or other) notice to you during the account creation process that Individual User Information and/or Identifier Information may be disclosed to an advertiser or other third party in the event that you continue the account creation process (regardless of whether such notice does or does not contain a method by which you may explicitly provide such consent)." This means if you miss a checkbox in the registration process or if they don't offer the option but just politely tell you (in small, small print), then you ain't protected.

All this shouldn't necessarily sway anyone from trying free e-mail, ('cuz we all know free stuff kicks). And I don't encourage using fake sign-up information, as a few of the services have clauses to actually prosecute for such shenanigans. I do, however, encourage you to think carefully about who you're trusting with what information and not to pick the quickest and easiest sign-up process.

And keep an eye on Hotmail. I'm suspicious.

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FAST FORWARD

WITH TOM HALFHILL

The Long Dark Tunnel

RSI IS REAL AND **PAINFUL** AND IT CAN **HAPPEN TO YOU**

TOM HALFHILL is a senior editor at *Byte* magazine and the author of two computing books. He first became interested in computers during the disco era.

After three long years, I can finally see the light at the end of the tunnel—the carpal tunnel, that is. Yep, that's how long it has taken me to fully recover (well, almost) from a repetitive strain injury that nearly ended my days in front of a keyboard.

Occasionally I'll meet a knuckle-dragger who still thinks RSI is a phantom ailment. "I've been typing on keyboards for years and it's never happened to me," they declare. Based on that scientific data, they conclude RSI is some kind of mass hysteria. It never occurs to them that injuries and diseases don't automatically strike everybody who's at risk. Most people who smoke cigarettes never get lung cancer. I've been driving cars for over 20 years, yet I've never been hurt in a car accident. And I was typing on keyboards for over 20 years before I suffered from RSI.

It's probably a form of denial. If you really enjoy an activity (computing, bicycling, dancing, sex), the last thing you want to think about is a health problem that could stop you from doing it forever.

Too bad. If you want to keep using your computer for the rest of this year and next year and the year after that, don't turn the page. My advice could save you years of gnawing pain. It might even save your career.

You've probably heard it all before: Take regular breaks, get up and stretch, blah, blah, blah. I never took that advice too seriously either, until the day I tried to pick up a floppy disk and kept dropping it because my fingers stopped working.

If you want to keep using your **computer**, don't turn the page. My **advice** could save you years of gnawing pain. It **might** even save your **career**.

My case, I learned later, was typical: I was an experienced, rapid touch-typist; I bulldogged my way through a project that demanded an uncommon amount of keyboarding in a short period of time; and I ignored the early warning signs because I didn't realize how unbelievably fast some minor wrist pain could lead to a serious injury.

My downfall was the Pentium Pro. (Hey, it's fashionable to bash Intel or Microsoft for everything these days, so I might as well blame my RSI on them, too.) In early 1995, I got a chance to write the first in-depth article on the new chip. I taped hours of technical talk with Intel engineers and product managers. My eager editors cleared 11 pages in the next issue. To make the deadline, I had to transcribe my tapes, write a 7,000-word manuscript, and draw the figures in only four days.

Pretty soon my wrists were hurting. I had experienced some minor aches before, but they always went away in a few days, so I didn't worry. I figured there would be time to recuperate after the story was finished. Surely a few days wouldn't matter.

Big mistake. The story got done, but my tendons felt like frayed dental floss. Every finger movement triggered bolts of pain that shot through my hands and wrists, all the way up to my elbows. Soon I could type with only two fingers, and I had trouble grasping small objects. (Lesson #1: If it hurts, stop!)

By coincidence, a colleague had suffered a similar injury a few months earlier when he had pushed himself through an enormous CD-ROM project. He urged me to see a doctor: "Not next week. Now!" (Lesson #2: Get help immediately. It's serious.)

Fortunately, my doctor works in Silicon Valley and sees many cases like mine. Not all doctors are so enlightened. He soon diagnosed the severity of my injury and prescribed a nonsteroidal anti-inflammatory drug. My doctor also prescribed a pair of steel wrist braces that I wore every night for the next two years. And I found an excellent book: *Repetitive Strain Injury* by Emil Pascarelli and Deborah Quilter (John Wiley & Sons, ISBN: 0471595330). (Lesson #3: Don't expect a quick recovery. It can take longer to recover from serious RSI than from an amputation.)

Many people don't realize that RSI affects more than your ability to type. For over a year, I had trouble opening jars, turning doorknobs, using screwdrivers, writing in longhand, and holding a steering wheel for long periods. I couldn't read books, magazines, or newspapers without resting them on a surface. Businessmen with "power handshakes" inflicted spasms of pain. (Lesson #4: Wear a fake bandage so you have an excuse to avoid power handshakes. Or threaten to kick their inconsiderate butts if they squeeze too hard.)

I've learned other lessons, too. Nothing helps you heal faster than not typing. Chilly rooms shrink your tissues and increase the friction on your tendons; to keep warm, cut the toes off a pair of athletic socks and pull them over your wrists. For the same reason, don't wear any bandage or brace that tightens your wrist. Buy a "wave" keyboard and prop up the front, not the back. Don't rest your wrists on a wrist pad while typing. If the mouse is causing your pain, try a wave keyboard with a built-in touchpad. Invest in a good adjustable chair and learn how to adjust it. Avoid using notebook computers, especially on airplanes. Open doors by pushing them with your shoulder instead of with the doorknob, which has probably contorted your wrist into a weak position.

The frightening thing is that I'm still not 100% recovered, even after three years. I'm about 90%. My doctor says I'll probably never be able to revert to my old habits–typing as much as I want, as fast as I want, with any keyboard or chair I want. Like a football player with a rebuilt knee, I'll have to pay attention to my body and work within my limitations.

Final lesson: Don't let this happen to you. It's real, and it hurts like hell. b

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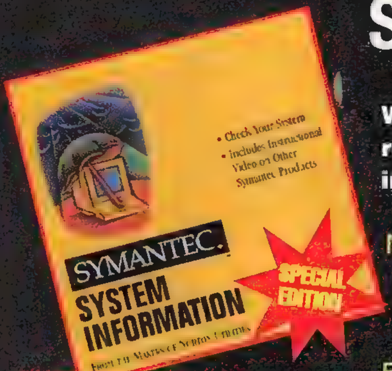
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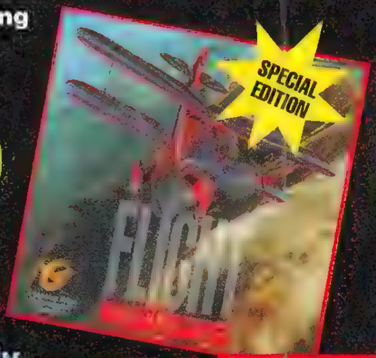
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Product Information Number 131

Chances are you haven't heard of ***Centaur Technologies.*** *And for good reason—they don't want you to. All they care about is whether or not your PC happens to use their latest progeny—the* ***WinChip C6+****, a low-cost Socket 7/x86–compatible CPU optimized for Win95 and DirectX.*

Sure, Andy Grove and his Intel minions could squash this liliputian challenger with one, aptly timed patent lawsuit, but Centaur's founder and president isn't worried. With his crack team of engineers and the financial backing of IDT, an international integrated circuit manufacturer, ***Glenn Henry*** *is*

PHOTOGRAPHY BY MARK MADEO

Mr. Chips

"Our MMX performs just as fast as Intel's, even on Intel's own **lying, cheating, stealing** benchmark. The Intel media benchmark is really horrible."

boot *How did you build an x86 from scratch?*
Henry It is very, very difficult. We started two years ago literally with no space, no equipment. We were using my home PC. We had meetings in my kitchen to deliver a working Pentium-compatible 200MHz processor. AMD had hundreds of people, spent hundreds and hundreds of dollars, and produced the K5, a total industry failure. All of AMD's previous attempts were literally lifted, they just copied the transistors.

We really did an impossible job, which was one of my goals originally to show Intel it could be done. No one but Coke can make Coke by definition because they have the formula in their vault. Pepsi may taste the same, but it's not Coke. So Intel would like to leave no one but them to build an x86.

So obviously my team is really special, really good—but if I can do it, other people can do it too. We're not the only good engineers in the world.

boot *Why butt heads with Intel?*
Henry I love processors. I have for 46 years. In the early 80s, I was an IBM Fellow, the manager of all of IBM's RISC processor activity here in Austin. I was the guy that went around IBM saying "RISC is king, x86 sucks." That literally was my mission. And in '84 and '85 I was doing a RISC product that came out roughly at the same time as the PC. Every week, I'd have to explain why my costs were twice what this PC thing was. And my performance wasn't that much better.

"For me it's a ***personal*** *thing.* >

So, when we finished that, I decided PCs were the way of the world. I switched allegiance—which was a big deal—and started working on PCs, even though they were considered some substandard form of life.

I wanted to build an x86 PC processor, and in those days Intel didn't own the world. As a matter of fact, IBM had invested in Intel to shore them up—Intel was actually on the verge of losing money. So I came up with a project inside IBM to build a low-cost, high-performance x86. My strategy at the time was: We [IBM] don't need Intel. Why would we, considering we had all this technology?

Unfortunately, it became unbelievably political. I had to go to New York every week to argue why we should be doing this. It wasn't a technical issue—it was bureaucracy. Hell, I spent a lot of time arguing with the President of IBM. After a great deal of frustration, I finally quit out of principle.

I went to Dell, but in the back of my mind was the project I never got to do—

building a low-cost x86.

Intel would have you believe that it takes hundreds of people and years upon years and a secret formula locked in the vault to do an x86. I've always liked doing things that can't be done. For me it's a personal thing. This may sound silly, but I believed a PC in every home would change the world.

It's easy to build a $500 or $600 PC with modern technology that does a lot, but the problem is: sitting in the middle of that thing is an Intel chip. When I started this project, Intel was charging $400 or $500 for their chip, which was ridiculously out of line. The chip costs $30, and Intel's charging $500? I don't mean to sound righteous, but that's bad. That's hurting the industry. People could make a profit selling it at $100, and sales would grow exponentially. Microprocessors shouldn't cost more than $100, and part of our theme here was to build something, price it really low—the cost of our WinChip is significantly under $50—and defy conventional wisdom.

boot ***A consumer walks into a local store and sees an Intel system and a WinChip system. What's the incentive to buy a WinChip system?***

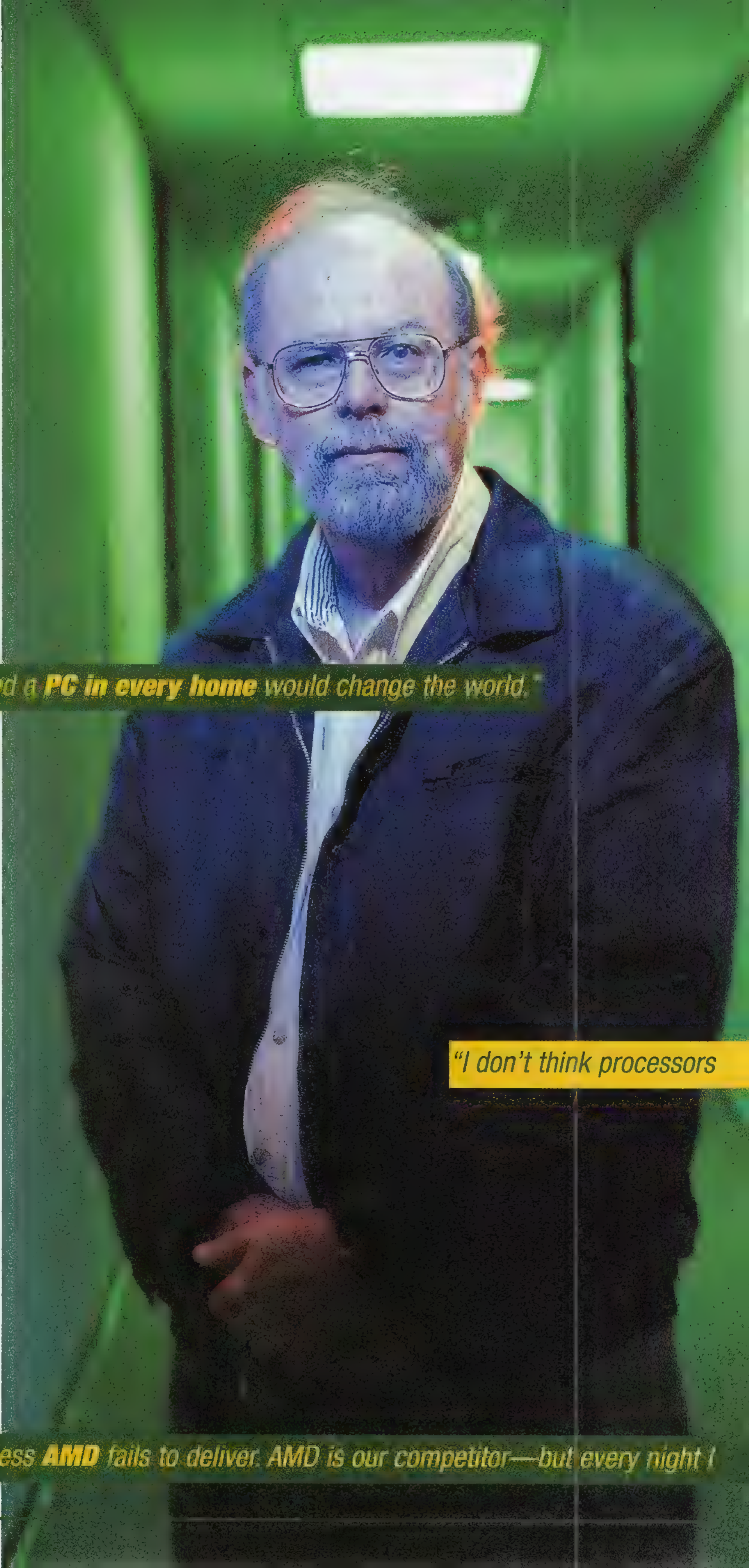
< This may sound silly, but I believed a **PC in every home** would change the world."

Henry A processor ought to be a commodity just like the chipset or the keyboard controller. You walk in there and there's two PCs. One's got an 8049 keyboard controller, one's got an 8051 … whatever. But no one knows, no one cares, right? What is the modem chip that's in there? What PCI controller? No one cares about any of that stuff, and they shouldn't.

But Intel has made a big deal out of the processor, and their "Intel Inside" campaign. All our chips are compatible; they perform well; they're roughly equal. The difference is a few percent at most between the faster thing and the slowest thing in the world. It just doesn't matter. So if it weren't for the "Intel Inside" advertising, no one would care about the chips. They would buy the system that has the features and the price they want. The key difference between our system and the Intel system is a couple hundred bucks, but ours performs exactly the same, except for maybe MMX and 3D. So if you're not a heavy-duty gamer—and by the way, heavy-duty gamers by and large don't buy $1,000 PCs—then our system will do everything the Intel system will do and be a couple hundred bucks cheaper.

boot ***OK. So just what is the current WinChip capable of?***

Henry Well, we made some fundamental trade-offs. We've been very open about what its focus is.



"I don't think processors

"**Socket 7** is clearly viable. Unless **AMD** fails to deliver. AMD is our competitor—but every night I

The current WinChip has been optimized for the Windows and business applications that most people use. What the current chip is not so good at is heavy-duty floating-point or MMX compilations. We're a lot faster than chips without MMX, but we're not as fast as the K6. And Intel still has the best floating-point operation.

boot ***But your second chip is geared toward 3D applications, right?***

Henry Six months after our first chip ships, we're going to ship our second. In this market, you win by responding quicker than others. And the 3D market is so fast that those who move quickest are going to win. The new chip is basically our current chip with substantially improved MMX and floating-point performance. It's at least twice as fast as our current chip.

boot ***How will you guys tackle the floating-point problems that plagued AMD and Cyrix?***

Henry Cyrix sucks and so do we today. With our new chip, we threw floating point away and rebuilt it twice as fast. Our approach—and I believe AMD's approach—is let's not spend a lot of money and make the x86 architecture floating point go faster. Let's spend the silicon doing things where the people use these instructions and give you a 5x improvement in graphics. That's a much better approach. Almost no silicon can speed-up 3D graphics by 3x to 5x, but it requires that people use those instructions. That's the big risk.

We've doubled our x86 floating-point performance and now we're about the same as Intel. Doubling that again would take a monstrous amount of silicon. It would take almost no silicon if you double it by including new and different instruction—a new MMX-like floating-point instruction, which is what we've done.

boot ***So what are some of the new instructions you've got built in?***

Henry Fast reciprocal square root for one. Doing a reciprocal square root on a Pentium today takes about 130 clocks. Doing a square root on our chip takes less than 20 clocks. It's pretty basic stuff: fast, floating-point integer conversion, fast reciprocal, fast reciprocal square root, very fast multiply.

boot ***Those instructions are compatible with DirectX?***

Henry No one is going to use our instructions specifically. So we'll write a routine to go into Direct3D. Our strategy is to be totally transparent. AMD and Cyrix are going out and talking to id Software and all the other developers out there saying "Here are our instructions—use them."

I'm not sure that's a good approach anyway, but it's certainly not a good approach for us. We're going to add these instructions, and we're going to work with Microsoft and for Direct3D I'll write the code myself.

Microsoft and Centaur then have to count on people using Direct3D. So what I'm counting on is the inevitable force of Microsoft APIs swallowing the world. I think a high-level interface to graphics is a good idea. I don't want to argue D3D versus OpenGL—they're both okay, but since Microsoft is readily supporting D3D—even though it's not very good (at least today)—it' s going to be the winner. But it will get better in time. And the concept is good. I'm a believer in a high-level API; that the more we can make it easier for an application to do complex things, the more applications we're going to have—and that's goodness, right?

Now, putting religious differences aside, we're agnostic on this; we don't care.

boot ***If Microsoft started endorsing OpenGL, would you do the same thing there?***

Henry Sure. In fact, it's trivial. With OpenGL—when it gets down to the geometry and transforms, there are subtle differences only a 3D expert would notice. The calling sequence is slightly different, but it would be trivial to add that.

boot ***If you added AMD's instructions, they'd be added to DirectX or Direct3D?***

Henry If I had AMD instructions I'm now a clone of AMD, and I can sit back and do nothing. I'm not going to argue with AMD's strategy, and I'm not going to agitate the industry—AMD is already doing that. I just get it for free. That's the advantage to me, the advantage to AMD of doing this deal is of course that it looks much stronger if several people are banded together against Intel. You have to work in concert. I think AMD understands that, we understand that—and it's a win/win for us and a win/win for the industry.

boot ***Aren't all these new instruction sets targeting gamers?***

Henry No, we're targeting games. I make a distinction. There are gamers and there are people who casually play games. But we're not really going after the heavy-duty gaming marketplace because we really don't think that's a very high volume in the sub-$1,000 PC category.

boot ***What's the optimal system for the C6?***

Henry A good low-cost 3D chip on a board. By low cost, I mean $80. I believe that there are several good 3D cards you can get today for $80, and three months from now it will be twice as good. A 3GB EIDE drive. The usual stuff—generic 3D sound card, 20x CD-ROM, and probably 32MB of memory. EDO versus SDRAM is an important issue to us. We're optimized to minimize bus traffic, but when we started, fast memory versus slow memory was a cost item and there's still a significant difference between EDO and asynchronous DRAM.

We have two philosophical approaches: Speed up the CPU or speed up the bus. And it turns out it's easier and actually more cost-effective silicon-wise to speed up the bus. So that's what we did. That's why we do particularly well with EDO memory.

boot ***Well then, just how fast is "fast"?***

Henry Our MMX performs just as fast as Intel's, even on Intel's own lying, cheating, stealing benchmark. The Intel media benchmark is really horrible—it's optimized perfectly in Assembly language for Intel's own product line. It's actually faster in business applications.

In addition, we added our own special 3D graphic instructions. The interesting thing is that AMD and Cyrix also had their own instructions and all roughly do the same thing differently. So quite a lot of people were asking us why don't we get together. By the time this interview comes out, we'll probably have done that.

boot ***So you're planning on joining forces with AMD and Cyrix?***

Henry Of course. We don't benefit by having our own instructions. We added them because it's better, for almost no size—remember we're focused on small size. For

***matter to customers** and it shouldn't be a household name. We're a **semiconductor** part; we're >*

*have to **pray for their success**. Without them, there won't be Socket 7."*

What's in a name?

boot ***Where did the name WinChip come from?***

Henry We made it up. Everyone else, including us, has a number (we're C6). In fact we picked the C6 because it sounded just like a K6. But we said "This is a consumer marketplace that we're going into. We need a name, not a number. And the name should have some meaning." So we optimized the chip for Windows, thus we're WinChip. We just thought it was better to have a branding name than an abstract number in the marketplace we're going after.

Playing with the big boys

boot ***What's it going to take to get a Gateway or a Dell to switch?***

Henry I don't think they ever will—they need very high volumes. Intel is the only one that can guarantee their kind of volume. Plus, Intel has a full product line. If Dell started buying non-Intel chips, they'd get less access to Intel's good stuff. They wouldn't get specs as early—it's a well-known phenomenon. And that's a big deal. I shouldn't say they'll never switch, but they're not going to switch until someone else can offer them everything Intel can and with a substantial cost reduction.

boot ***Are you talking to any top-tier companies?***

Henry Yes. But we're not even trying to sell to them because we couldn't supply their volume demands today. We can sell all we can make for a while without fooling with those guys, so why take on the heartache? There's heartache on both sides of a guaranteed contract that says we'll deliver a million.

That's always been Compaq's problem. Compaq consumed so many chips, that even though they've occasionally made it clear that they're not that great a fan of Intel, no one has been able to supply their volumes except for Intel.

boot ***So, who are your customers?***

Henry We're going after the local Mom and Pop down the street, who buy a motherboards from Taiwan and buy processors from us. Pop puts it together and Mom does tech support and the son delivers it—that type of thing. Because they can gross $30 or $40 more, it's a big deal, and for those people our chip is perfect. The local guy has no strategic interest.

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less than a square millimeter of chip size, we added instructions that speed up geometry and lighting transforms by about 2x to 5x.

But the industry would be better off if all the alternatives to Intel banded together and shared the same specs. So we have publicly said, "We will throw away what we did and use AMD's or Cyrix's," but AMD's the better choice if they'll work with us. And all I can say is we're working with them, but we're not ready to announce anything yet. We're very happy to clone AMD, if you want to put it that way, because I think that's the best thing for the alternate marketplace, which is the best thing for the PC industry.

boot ***So Centaur can't dent Intel's armor without help?***

> "Intel has spent **$100 million** on running ads convincing you not **God's answer** to anything."

Henry Of course not. That's ridiculous. Even if you could do it technically, which is very, very difficult because Intel *is* technically competent, you can't because of two other factors. First of all, Intel's marketing muscle is like Microsoft's. They are more powerful as a marketing company than they are the technical company.

Second, their manufacturing prowess. This'll be a 100-million-chip year. If Intel died tomorrow and said, "We give the market to Centaur," what are we going to do? No one else could make 100 million chips. Intel probably has ten or twelve foundries. This is AMD's problem today—whenever Intel lowers their price, AMD will lower their price, but they can't make enough of them. So little old Centaur isn't going to make any dent on a 100 million marketplace.

One of the things I learned at IBM was to spend little and promise little. We have spent very little on this, and we'd laugh all the way to the bank if we could just sell a million of these things. Secretly, our dream is to sell a lot more than a million. A million might be a big deal to us, but to Intel it's nothing—they won't even notice. They'll just think someone stole those chips.

boot ***Is MMX a sham?***

Henry Intel has spent $100 million on running ads convincing you that if you don't have MMX you're not a *real* man. But go and try to find a *real* MMX application, particularly one that runs. You can't. The only games that use MMX are trashers. All the good games don't use MMX. And the business applications that use MMX (such as *Photoshop*) aren't applications people run on sub-$1,000 PCs. The 3D stuff does make us substantially better at games, but it's a real marketplace rift. But as much as anything, it's a marketing knock-off.

boot ***Do you think there's a real incentive for people to use MMX? Is it really worth your time to incorporate it into your new specs?***

Henry For certain applications, yes. For image processing it is a big deal. But it's relatively useless for writing 3D pipelines. It is useful for sound and classic DSP applications. But those are specialized applications. If you're going to write a business application, it's useless. For most games it's useless. For a *Photoshop* or a sophisticated audio effect, simulating synthesizers and things, it is useful.

boot ***But since people aren't running*** **Photoshop** ***and things like that on your sub-$1,000 WinChip-based PCs, why worry about MMX at all?***

Henry The people who make PCs need to hype technical features—"our thing is bigger than their other thing." But the WinChip is a very small chip, and for very little cost, we can double the MMX performance. The PC industry is driven too much by marketing and hype. I don't think MMX has much use. I think it was totally a ploy by Intel to charge more money. So it's a marketing ploy and, in this case, rather than buck the tide, we just did it too.

boot ***So you've joined in the ploy?***

Henry Why would I argue against it? But we did spend more energy on things we thought were important—speeding up business applications and speeding up 3D graphics, which I do think has some real use. Where are the good games that use 3D? They're all over. But where are the good games that use MMX? Those are not great games.

boot ***Well, what about AGP? How will AGP affect the WinChip?***

Henry It won't, other than raise sales. AGP just totally trashed out. It's just another bus. Sitting in back of the processor we don't see any of that. We see a Socket 7 bus that goes out to a control chip. God knows what's on the other side of it. It has zero affect on us.

boot ***Do you see this trend continuing?***

Henry Intel's got a real problem. They have to sell 80 million chips this year, 90 million the next year, etc. And the world is already saturated with PCs. How are they going to convince people to throw away all those old PCs and do something new? That's a major problem. Dell and Gateway would die if the average life of a PC wasn't two years, right? The PC lives longer than that, but people turn them over faster. So what Intel tried to do is to create a brand-new application doing things you never heard of. This year it will be something different. No one knows what it is, but it has to be something that a PC can't do today because for existing applications PCs do a pretty good job. There's a limit to how fast you need to run business applications on a PC.

boot ***Is there a speed limit? Do consumers care about 400MHz and 500MHz parts?***

Henry Only for the new emerging media applications. There's a limit in any given application of how much technology you can use. And for classical business PC use, we're approaching that limit relative to processor speed.

3D graphics are useful and important, but once you hit 60fps, it doesn't need to go any faster. You're dealing with human interaction. There's a limit to how fast things need to go.

boot ***What speeds can we expect with your new parts?***

Henry We're shipping 180s and 200s today. The new chips will be 300MHz and up. A year from now we're targeting 500MHz.

boot ***Speaking of speed, WinChip is optimized for Windows, correct?***

Henry Yes, but it runs everything. Linux lets us do things with virtual memory that Windows doesn't do, so we support those things, even if they're not the fastest. Our chip is very heavily tuned. We did extensive analysis of what PCs do from a processor's viewpoint: What instructions, what sequences, bandwidth. And where we had to be fast, we put hardware; when we didn't have to be fast, we used microcode, because that's the smallest transistor known to man. So we have more microcode than other processors. On Windows 95 we're equally as fast; on Windows NT, we're about 4% slower.

boot ***As NT becomes a lot more popular, do you foresee NT optimizations?***

Henry Sure. Our next chip fixes that 4%.

that if you don't have ***MMX*** *you're not a real man. But go and try to find a real MMX application* >

boot ***Are there any apps you know of that don't work with your chip?***

Henry No. I can tell you how to write one, but I can tell you to write one that wouldn't run on Intel chips too. All modern chips have machine-specific registers; very low-level things that are handled by the BIOS. Applications don't use those because the machine-specific registers of the Pentium, the Pentium Pro, and the Pentium II are all different.

With a Cyrix chip or a K6, you have to have a BIOS upgrade because of the machine-specific registers. We do too. However, on a large number of boards we don't even need a BIOS upgrade. You can plug our chip into a motherboard that has Award BIOS on it and we run. Of course, it will identify funny, returning a message that says "this is a 286 running 1MHz" or something silly like that, but we run fine. So we actually put more energy in the compatibility than Cyrix or AMD because we knew no one would ever do anything for us.

boot ***OK, but what happens with applications that specifically look for an Intel chip or simply look for MMX extensions?***

Henry There are a couple of applications that read the CPID string for a genuine Intel chip. This is a crime against humanity. Intel has convinced developers they should read for their CPID string, but the only people they've convinced have been convinced by paying them money. But that's just my cynical opinion. Anyway, there are some programs that look for a genuine Intel chip and refuse to work if it doesn't see one. But we have a way around that which I think is very clever.

When you execute CPID, it returns its character string. We have a feature that allows you to dynamically change that character string to anything you want.

boot ***Will Centaur and WinChip ever be a household name?***

Henry I don't think we'll be a household name and I don't care. I don't think processors matter to customers and it shouldn't be a household name. And I don't think that's necessary to be successful. Who is the household name in memory chips? We're a semiconductor part; we're not God's answer to anything. We'll make money selling parts, and we can sell plenty without being a household name—plus, we're doing this for the joy of it. It's a mission that's fun to do.

Intel spent $100 million last year advertising MMX, right? And if you ask common people, "What the heck is MMX?" they think it has some thing to do with space people disco dancing. They've seen the ads but they don't know what they're touting.

boot ***How about Slot 1? Are you guys planning on looking at that?***

Henry Of course we've already looked at it. We don't want to do it unless we have to; Slot 1 has no technical merit—it actually has technical demerit. But Intel's on a campaign to make you go proprietary for Intel—and is going to spend a billion dollars on it. If they can convince the world that you have to have a Slot 1, then we'll have to do it.

I don't think they'll be successful.

In 1987 I was heavily involved in IBM, fighting against IBM's decision to go proprietary. I don't know if you remember, but they did the thing called the Microchannel. Soon thereafter I quit IBM. I said it was a stupid thing. I spoke out in public forums—I used to be the guy who debated the IBM guy. It was the same thing: a proprietary thing. It had no value other than some esoteric multiprocessing and it was going to cost more. In that particular case the industry rebelled—led by Compaq, who said "we're not doing that." And all the Dells and Gateways clustered under that umbrella and the market split and of course Microchannel is in the Hall of Shame and isn't made any more, and IBM's share of the market went from 80% to 9% or something. At the Fall Microprocessor Forum, I was on a panel session and when asked about the advantages of Slot 1, the Intel guy had a hard time and finally choked out, saying "Well, I personally think it is, but it's a very subjective thing." Right. There is *no* advantage to Slot 1. Intel's clearly doing it just to drive everyone else out of business.

By the end of the year we'll do a backside L2 on the chip. Our chip's so small, we're doing 0.25 micron technology and

A boy named Sue

[illegible] ***Does Intel give a hoot about about Centaur?***

[illegible] I don't know. The standard question we get asked is, "Will Intel sue you?" And of course, we have no idea.

[illegible] ***Well, what would the basis for a lawsuit be?***

[illegible] Oh, patent infringement. Intel's position has been clear: If you develop an x86, you must infringe their patent. They sued Cyrix. AMD has a patent cross-license, but they sued AMD on other issues. We don't believe, of course, we infringed any patents, but in this country you can sue anyone.

But they haven't done that, which is actually a surprise to most industry analysts because historically, if you dared to enter the marketplace, they'd try to step on you.

Personally, I believe they should welcome Centaur. In fact, Intel should be paying us money. Guys like me are actually good for Intel, given all those monopolistic suspicions.

And besides, I'm not going to take business away from Intel. If I take business away from someone, it'll probably by Cyrix and AMD. Heck, Intel should send money to encourage me. Unfortunately, they haven't yet [laughs].

Again, I don't think we're really a threat to Intel. In our first year we might ship a million systems. That's round-off error to Intel, but a big deal to us. I think our existence is much more important in the marketplace than our volume.

adding L2. You do those things and there's no technical advantage on Slot 1—it just adds cost. So we looked at it and said we're not going to do it unless Intel forces us.

boot ***If you are forced to do it, can you?***

Henry We're back to the old argument of intellectual property. It's not trivial, but neither is a 100MHz Socket 7. For that matter, neither is building a Pentium chip. Can we do it? Technically, yes. Do we have a cross-platform license with Intel? No.

boot ***What do you think of the Super 7 Initiative?***

Henry You have to make Socket 7 more competitive. Making it faster and cheaper, and adding support for high-speed L2s, are all good technical things.

From a marketing viewpoint, bundling those together—putting them under a name—is a good idea. I hate this stuff personally, but it's a good idea. I'll be a Super 7 member, arm-in-arm with AMD. We're all doing the same thing; but it's just a marketing ploy.

boot ***How long do you realistically expect Socket 7 to last on the Windows platform?***

Henry In a year and a half, the world will be in one of two different places: One scenario has Intel with 100% of the marketplace, AMD will be out of business, and I'll be living on my Dell stock, trying to do robotics or something like that. If Intel is successful with moving the world to Pentium II, and Slot 1, etc., they may very well move the whole world there, whether it makes technical sense or not. Such things have happened and Intel has tremendous power to sway the user.

The other scenario says both AMD and Centaur are successful in an alternate marketplace where Intel maybe has 70% of the market. Probably by then the alternate marketplace has 30%. This is what happened in the PC world. And in that case, that 30% will be Socket 7, and it'll be very viable. It's not a technical thing. Socket 7 has a long life span to it. It's going to 100MHz this year with the 0.25 micron technology, it will innovate L2 cache. Slot 1's got nothing, other than multiprocessing, but I don't think multiprocessing will be important for a volume marketplace, even then.

A 100MHz Socket 7 is as fast or faster than a 100MHz Slot 1 in any processor environment and it's a hell of a lot cheaper. Now, in most places in the world that's the definition of a good deal, and there's no reason you can't put L2 cache on top of Socket 7, just like they do. They've got a bus, and there's an L2 cache living inside their slot thing. Whether or not you do it as a module or you do it on the chip is irrelevant, right? You can plug the thing with L2 cache and a processor into a Socket 7; the bus will easily run 100MHz. As long as AMD is there, the chipsets will be developed to run on 100MHz and motherboards. It's a good solution that's cheap. The only reason that wouldn't work is because Intel is going to threaten, push, cajole, and spend hundreds of millions of dollars on marketing—and they *may* be successful. The only reason Intel didn't raise the bus frequency beyond 66MHz for years is because they wanted to do Slot 1. Intel wanted to convince the world Socket 7 is substandard. That's technical bullshit.

We're building our strategy around the idea that Socket 7 is clearly viable out until well into '99. Unless AMD fails to deliver. This is terrible—AMD *is* our competitor—but every night I have to pray for their success. Without them, there won't be an infrastructure to do Socket 7.

boot ***In the worse case scenario, how long can Centaur survive?***

Henry We are in business to sell. The worst case scenario is that we can't sell, but there appears to be no evidence of that. I think we'll survive forever.

boot ***Is Cyrix stealing any of Centaur's thunder with their alternate architecture?***

Henry A little bit, but not a lot because MediaGX has two big deficiencies and only a minor advantage. Those two big deficiencies of course are performance—it's really a dog and its quasi-unique motherboard design.

The only product that uses one of those things today, the Compaq Presario, is not terribly competitive. If you look at price/performance, it's really poor. You might save $30, but we would be twice as fast with more flexibility. And if you want to put in a 3D card, put it in. That thing has integrated the world's lousiest graphics adapter.

And so next year they're going to do a new chip with a better graphics adapter. And three months later *it* will be obsolete. I'm just not a big believer in integrating things like graphics. Memory controller, bus controller—fine—because they don't change. Audio and particularly video change every three months.

> < "that runs. You can't. It was totally a **ploy by Intel** to charge more money."

boot ***Almost everyone we've talked to during these interviews agrees that Andy Grove is the smartest guy in the industry. Do you admire his famous paranoia?***

Henry No. Having worked for Michael Dell for five years, I think Michael is the smartest guy in the industry.

boot ***OK, we'll bite. Why?***

Henry First off, he's just intellectually smart. But he really understands the customers and their buying proclivities. Dell started from nothing and right now it's an $8 billion company. Intel has a monopoly lock—they have patents, they have their processor, and they have a factory. If you inherited Andy's job tomorrow you'd do very well because you've got everything rolling. Michael started with nothing. It's a lot harder to be successful by understanding marketing and support and what people want in PCs then when you own a technical monopoly. That's taking nothing away from Andy, but I saw Michael go from nothing to building a multibillion dollar business without any technical secrets, without any better technology, without any better fabs. Just by cleverness. And I think that's difficult—not taking away from Intel again, but they do have an

Runnin' with the devil

boot ***What about Microsoft? Have they contacted you?***

Henry We actually are working quite closely with them on our 3D graphics instructions. They reviewed the specs, gave us hints, and said they would work with us in supporting Direct3D. So at the technical level, the guys in their D3D group have been very cooperative. There's also a guy in the NT group we've been working with on the 3D instructions. But by and large, since we're not going to be leading the pack adding new features, we don't have much reason to talk to Microsoft.

I'm the epitome of cloneness and proud of it.

Our engineers feel they control our destiny. Every decision was made here. We didn't even send a spec to IDT. They just sent money and trusted us. Every feature of the chip that makes it sell or not sell is totally engineering-driven. We needed no help other than from manufacturing to build the thing. And that's an engineer's dream. Most engineers who've been around any period of the time will tell you they did this brilliant work of art and the stupid salesmen couldn't sell it or the stupid marketing guys got it in the wrong marketplace, etc. So we intentionally avoided all that.

This is the best job I've ever had, and it's fun. But to make it that way I had to remove my dependencies on everyone else. I don't mind being dependent upon myself and my guys. If we fail, we fail; but we fail because we couldn't do it. Which is a good environment for an engineer.

"There is no advantage to **Slot 1**. Intel's clearly doing it just to drive everyone else out of business."

edge because of that quirk of fate. It didn't matter whether the 286 was a piece of cow shit or actually very good.

boot ***If you could run Intel for one day, what would you do differently?***

Henry I would try to make them much more responsive to what the real customer needs are. By "customers," I don't mean individual customers, but what the marketplace is. Intel has acted with technical arrogance. I have no complaints about their products. But they have built products because they wanted them to look that way. They spent billions of dollars on high-end things. If Intel would've sold a good processor for $100, the marketplace would have expanded, right? So what I would do for one day before the board of directors caught me for lowering gross profits (because that's been the problem)? I'd try to expand the marketplace by getting Intel to focus on what it is that people want to buy and not try to force them to buy what Intel wants to sell. I believe Intel hasn't built the right products. A $500 Pentium II in a Slot 1, is a perfect example. People didn't want that. Intel just decided, "We're going to fix AMD." And if they have their way with the Pentium II and Slot 1, we'll once again see the return of low-end $500 processors, which is horrible.

boot ***If there's a catch phrase for Centaur, what would it be?***

Henry I actually wanted to call it the Volks Processor—a processor designed for what people do. But PR said no.

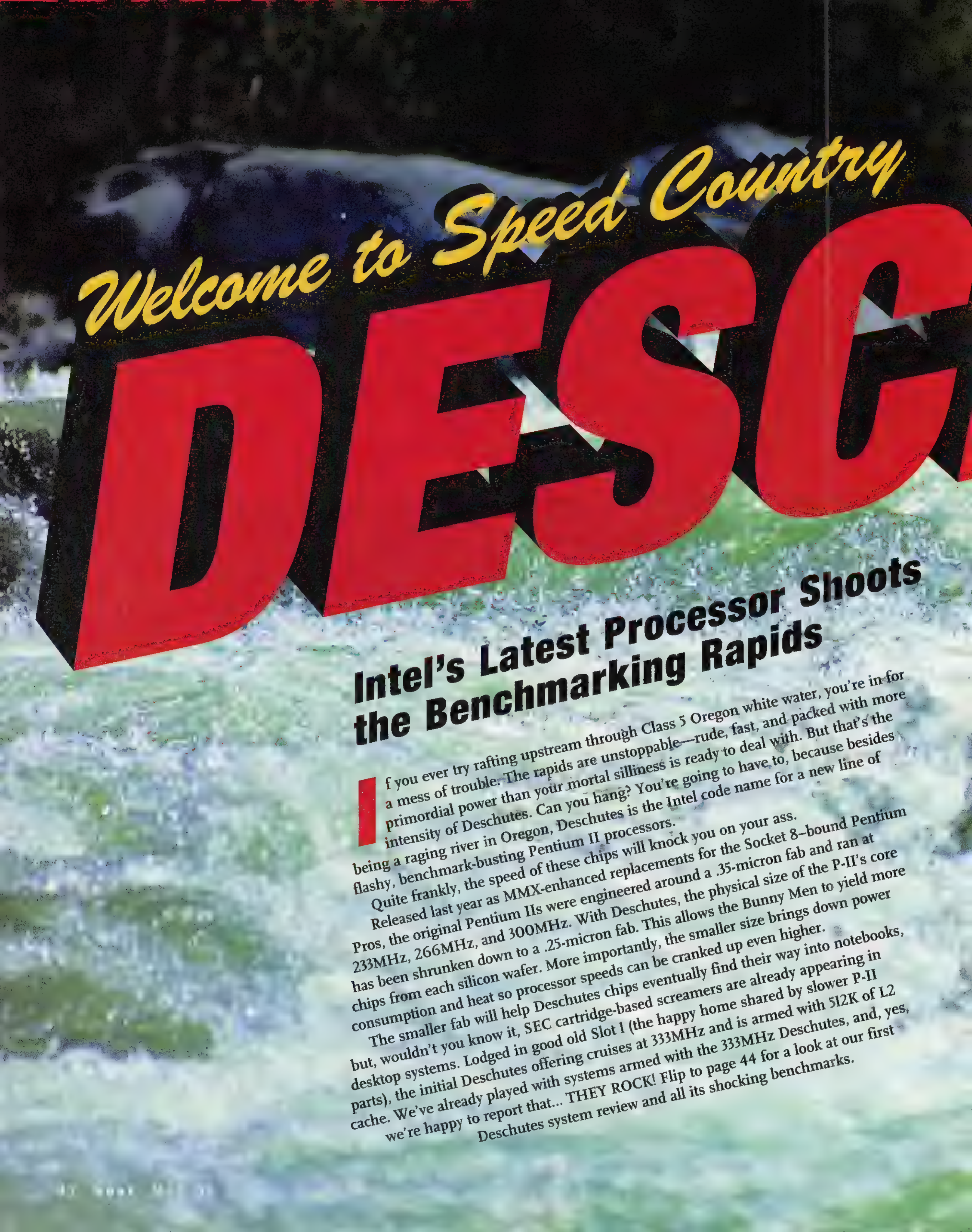
RISCy business

boot ***What's the next big processor: RISC, CISC? A combo?***

Henry It isn't classic RISC. The time has passed for that. RISC designs are now as obsolete as x86 designs. If you want to build the fastest thing in the world, ignoring software hype, the new architecture approaches are derivatives, a combination of some RISC and a thing called VLIW.

Modern RISC machines take a serial set of instructions and try to improve them so they can execute four or five at once. But they're starting with the serial string. That's very inefficient. The VLIW architectures take four or five instructions and pack them together and say, "That's one big instruction." It just tells you how to do four or five things in parallel, and that's much more efficient. Some of the stuff Intel is doing on their new Epic architecture is good, but it's not classic RISC.

The x86 is continually speeding up. So I actually believe that x86, as an external architecture, is going to live for a long time.



Welcome to Speed Country

DESC

Intel's Latest Processor Shoots the Benchmarking Rapids

If you ever try rafting upstream through Class 5 Oregon white water, you're in for a mess of trouble. The rapids are unstoppable—rude, fast, and packed with more primordial power than your mortal silliness is ready to deal with. But that's the intensity of Deschutes. Can you hang? You're going to have to, because besides being a raging river in Oregon, Deschutes is the Intel code name for a new line of flashy, benchmark-busting Pentium II processors.

Quite frankly, the speed of these chips will knock you on your ass.

Released last year as MMX-enhanced replacements for the Socket 8–bound Pentium Pros, the original Pentium IIs were engineered around a .35-micron fab and ran at 233MHz, 266MHz, and 300MHz. With Deschutes, the physical size of the P-II's core has been shrunken down to a .25-micron fab. This allows the Bunny Men to yield more chips from each silicon wafer. More importantly, the smaller size brings down power consumption and heat so processor speeds can be cranked up even higher.

The smaller fab will help Deschutes chips eventually find their way into notebooks, but, wouldn't you know it, SEC cartridge-based screamers are already appearing in desktop systems. Lodged in good old Slot 1 (the happy home shared by slower P-II parts), the initial Deschutes offering cruises at 333MHz and is armed with 512K of L2 cache. We've already played with systems armed with the 333MHz Deschutes, and, yes, we're happy to report that... THEY ROCK! Flip to page 44 for a look at our first Deschutes system review and all its shocking benchmarks.

HUTES

boot
intel
pentium II
PROCESSOR
intel.

Oregon's Processor Paradise

BY ANDREW SANCHEZ

The Many Faces of Pentium II

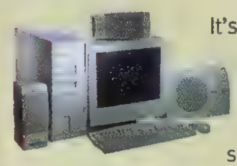
Here's the quick-and-dirty 411 on the Pentium II family members—Vanilla P-II Baby Bear, Slot 1 Deschutes Mama Bear, and Slot 2 Deschutes Papa Bear.

Category	Vanilla Pentium II	Slot 1 Deschutes	Slot 2 Deschutes (Estimated release date Q3/98)
Core CPU Speeds	233, 266, 300MHz	333, 350, 400, 450MHz	350, 400, 450MHz
System-bus speeds	66MHz	66/100MHz	100MHz
L2 cache size	0K, 256K, 512K	512K, 1MB, 2MB*	512K, 1MB, 2MB*
L2 cache speed	1/2 core CPU speed	1/2 core CPU speed	core CPU speed
Core-logic chipset	440FX, 440LX, 440BX	440LX, 440BX	440BX, 450NX
Fab width	.35-micron	.25-micron	.25-micron
# of processors supported	2	2	4
PRICING**	233MHz $268 266MHz $530	333MHz $919 350, 400, 450MHz $TBA	300MHz $739 350, 400, 450MHz $TBA

** estimated L2 cache sizes*
*** as of 01/07/98*

NEC Direction SPL 333

Fastest gun in the bootLab



It's not the best gaming machine, but the Deschutes-driven NEC SPL 333 still throbs with supreme PC power, kicking ass across all subsystems and setting new bootLab records in three of our most telling benchmarks. If you can't muster the remarkably inexpensive direct order price, you should at least use this system as a model for your own upgrading exploits.

The dream centers around the 333MHz CPU. Sitting purdy in a 440LX Intel Atlanta motherboard and teamed with 64MB SDRAM, the processor chalked up a gaudy 157 in our basic bootMark test, breaking the previous high of 145, which was achieved by a 300MHz part. Even more shocking, the SPL 333 scored a chart-destroying 429 in our SYSmark32 test—that's 125 points higher than our previous top mark! SYSmark32 uses kernel code from eight Win95 business apps to gauge how well systems crunch algorithms and draw screens. The SPL 333 got particularly freaky while peeling through *CorelDraw*, Lotus *Freelance Graphics*, and Microsoft *Powerpoint*, suggesting the combo of the CPU and Diamond Viper V330 AGP video card might be the best battery you'll find for consumer-level design tasks.

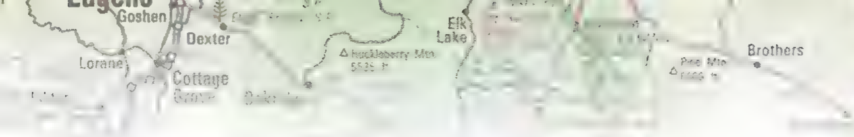
The 6.4GB IBM DeskStar 5 UltraDMA hard drive keeps pace with wicked fast performance, so you don't need to worry about drowsy reads and writes while your processor is buzzing along. And the score of 3682 in the CD-ROM read test easily busted the roof of our just-revised benchmarking scale, so you can rest-assured the 32x NEC A810SM CD-ROM drive is a keeper. You also get a Zip drive to handle all the run-off from your projects.

Exquisite Altec Lansing speakers round out this superfast, low-priced package. Of course, if you simply must keep spending, you're given the option to buy a 19-inch Hitachi CRT-based monitor for just $750. Can you do much better? Well, yes. The lack of any real audio hardware—c'mon NEC, Yamaha OPL3?—is a problem. We've also seen much faster Direct3D frame rates from the same Riva 128–based AGP card (this issue's Micron machine scored 11 frames faster in the *Foresaken* benchmark using the exact same video card and a *slower* CPU).

Nonetheless, the SPL 333 is a kick-ass machine. If you don't realize this as soon as you boot—the desktop color is preset to a stark, let's-get-down-to-business black—you'll learn your lesson when you pull off the sliding side panel. Inside you'll find the most upgradable of motherboards, with PCI and DIMM slots sitting unobstructed. And please note the three CPU fans (one is lodged in a massive aluminum heatsink). NEC said two fans would have sufficed in most 333MHz computing environments, but decided to go with three because most hardcore PC nuts permanently remove their cases, thus reducing the airflow necessary for optimal heat dispersal.

Imagine that: a system expressly designed for power users. You'll only find it via direct order, but that's a good thing. Keeps the novice riff-raff away from this purring muscle machine.

—Jon Phillips



Welcome to Speed Country DESCHUTES

Even faster speeds are expected in the Slot 1 realm, although Intel has yet to officially announce them. As Deschutes continues to pump up the megahertz, that old 66MHz system-bus speed will have to give. Slot 1 *will* eventually get a 100MHz system-bus-ready processor (to be teamed up with Intel's 440BX core-logic chipset). By applying typical bus multipliers—3.5x, 4.0x, 4.5x, etc.—to that 100MHz spec, you can expect 350MHz, 400MHz, and conceivably 450MHz parts to appear in the Slot 1 scenario. "The true game aficionado will drool over a system with a 400/100 processor plus AGP in the second half of '98," says Richard Dracott, Intel's Director of Marketing. "The fastest processor around for desktops will be the Pentium II 450MHz processor, running with a 100MHz system bus."

On the notebook front, Intel plans to unleash a .25-micron Mobile Deschutes at 233MHz, 266MHz, and 300MHz within the coming months, marking the first time notebooks will move beyond the tired Pentium with MMX realm. Following all the design parameters of the current Slot 1/P-II paradigm, the biggest difference between Mobile Deschutes and its desktop brother will be a smaller formfactor cartridge.

But even with core processor speeds running up to 450MHz, two performance bottlenecks stand in the path of Slot 1 Deschutes CPUs. The first obstruction is the L2 cache-to-CPU bus speed—it runs at half the speed of the core processor. The second obstruction is the inability to host larger amounts of L2 cache—the current SEC formfactor is already maxed out at 512K of BSRAM, and Intel knows it.

So what do you do when your evolving CPU technology outgrows your Slot 1 formfactor?

Simple. You make a new slot.

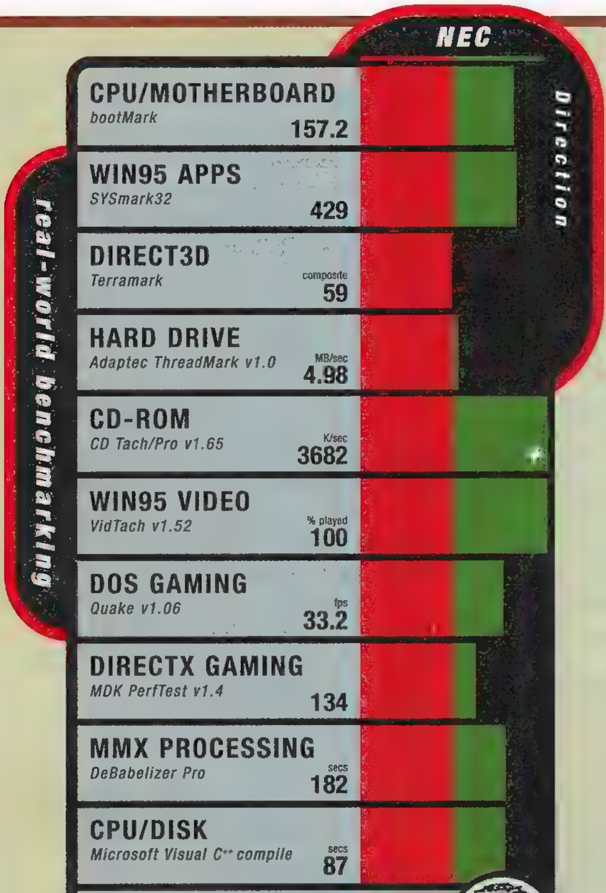
Slot 2: Full Speed Ahead

By Q3 of 1998, Intel will likely ship what many consider the true heir to the Pentium Pro throne—Slot 2 Deschutes.

For those of you who missed our preview back in *boot* 14, Slot 2 is Intel's forthcoming processor interface. It will live alongside Slot 1 in the grand Pentium II scheme of things. Resembling an elongated Slot 1 bus, the larger interface will accommodate a larger processor footprint, which in turn will house a larger, faster L2 cache. Intel has yet to confirm L2 cache sizes, but it guarantees they'll be "bigger than 512K." You should expect 1MB to 2MB of tightly coupled L2 cache. The L2 cache-to-CPU bus speed will also finally meet the Pentium Pro's spec of running at full core CPU speed, so a 400MHz Slot 2 Deschutes will have L2 cache running at a full 400MHz straight on through.

While Intel hasn't etched in stone the entire new speed lineup, you can expect Slot 2 processors to at least match the faster Slot 1 CPUs: 350MHz, 400MHz, and 450MHz. "In the server-workstation world, the fastest one will be a Slot 2 450/100 with up to 2MB of full-speed L2 cache," says Dracott, discussing a CPU with four 512K BSRAM cache chips onboard.

The bigger cache doesn't come without a price. With current Slot 1/P-II processors, there's no problem getting large



Price $2,200 (add $500 for 17" monitor; $750 for 19")
Company NEC
Phone 888.863.2669
URL www.nec.com

boot verdict
9

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

under the hood

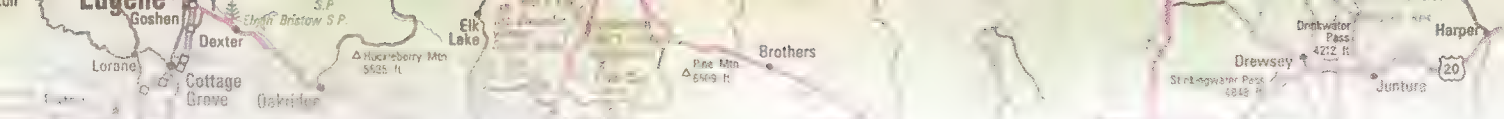
THE BRAINS	
CPU	Intel Pentium II 333MHz
L2 CACHE	512K BSRAM (internal)
RAM	64MB SDRAM
Motherboard	Intel Atlanta 440LX
THE BRAWN	
Video	AGP Diamond Viper V330 (Riva 128 Chiset, 4MB SGRAM)
Hard Drive	6.4GB IBM DeskStar 5 Ultra DMA33
CD-ROM	32x NEC A810SM
Expansion Bus	One AGP, three PCI, one ISA, one shared PCI/ISA
Fax/Modem	US Robotics 56.6Kbps
I/O Ports	Two USB, two serial, one parallel
THE BEAUTY	
Display	NEC C700, 17-inch, 0.27mm dot pitch, 1280x1024@60Hz
Sound	Yamaha OPL3-5A3
Speakers	Altec Lansing ACS410s with ACS251 subwoofer
Other	Zip drive, Microsoft Intellimouse

EXPANSION MAP

AGP	Diamond Viper
PCI	Free
PCI	Free
PCI	Free
PCI	Free/shared
ISA	Free/Shared
ISA	US Robotics Modem

THE BUNDLE Microsoft Windows 95 I Microsoft Office Small Business Edition

boot	down
:44	:06



quantities of inexpensive BSRAM to fill those L2 caches. But by upping the L2 cache size, Intel will be forced into the Pentium Pro–mode of manufacturing its own L2 cache memory—a process that will bump the price of Slot 2 Deschutes well over the $1,000 mark.

Despite the high price, expect all your favorite OEMs to begin selling Slot 2 Deschutes machines around August. And with the introduction of these badder beasts, expect price cuts around the same time frame. Intel is aiming Slot 2 at the ultra-elite crowd, and with a little help from the appropriate core-logic chipset, you'll be able to put as many as four processors into a system.

But which core-logic chipset should you go with?

It's in the Chips

If you're looking to immediately play footsies with Slot 1 Deschutes processors, the Intel 440LX is your core-logic chipset-du-jour. This two-chip setup officially maxes out on a 66MHz system bus, although many motherboards we've seen (including Tekram's P6L40-A4 and Abit's LX6) have the option for 75MHz and 83MHz system-bus speeds—for testing purposes *only* (yeah, right). Current 440LX specs include support for up to 1GB of system RAM (512MB SDRAM or 1GB EDO), USB, Ultra ATA/DMA devices, and PC98 standards. A lower-cost, stripped-down version of the 440LX may be released alongside cacheless P-II processors in an attempt to combat the Socket 7 AGPsets from AMD, VIA, and SiS.

But the 440LX has two big bottlenecks for extreme bootBoyz and bootGrrlz—a two-CPU maximum and the dreaded 66MHz system bus. Throughput gets logy when you couple a 2x sideband AGP card with 100MHz SDRAM and all those frothy high-res AGP textures have to be squeezed through a slower 66MHz system bus.

Intel's forthcoming 440BX core-logic chipset will fix the 66MHz bottleneck and give Slot 2 users all the support they need. You'll be able to get wet with a full 100MHz front-side bus and 100MHz SDRAM support (although there will be issues when attempting to match up older 233MHz and 266MHz CPUs with the newer 100MHz bus speeds and multipliers). Manufacturers expect to begin engineering sample parts by the time you read this, which means you should see motherboards armed with the 440BX around July or August.

EDO DRAM owners, sadly, might be out of luck, as the 440BX will most likely support only SDRAM—so get those DIMMs ready. Also, AT case owners may have to fork over the ducats for an ATX case and power supply: The 440BX requires an ATX 2.1 power supply (a requisite of Microsoft PC98 power management specs). If someone decides to do an AT 440BX motherboard, it will most likely be armed with an ATX power supply connector, forcing AT case owners to pony up for another power supply.

If you yearn for quad-processor power, look no further than Intel's 450NX. Appearing sometime late this year and handling up to 1GB of SDRAM, the 450NX core-logic chipset will support and use the new PIIX6 South Bridge chip (which, by the way, the 440BX will support). This new South Bridge chip will offer cool features such as IEEE 1394/Firewire and dual USB support (for quad ports), and may possibly come in ready for the forthcoming Ultra DMA 2 specification.

With four processors in tow, how will all that silicon fit on a standard ATX or AT motherboard? Simple—it won't. In fact, it was a labor of love trying to fit

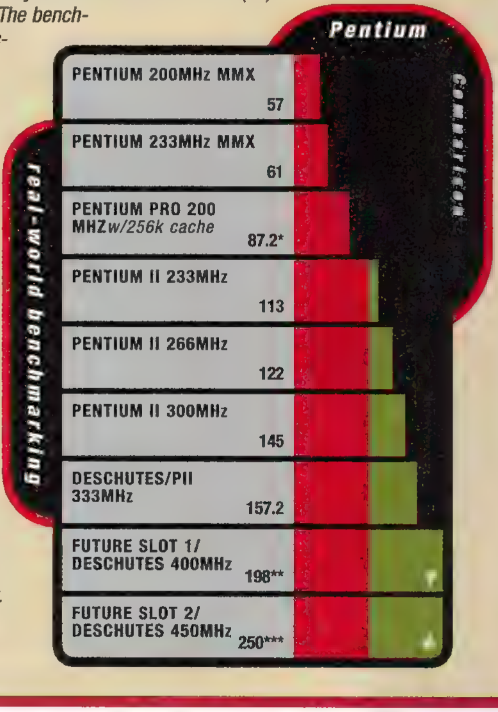
How Does Your CPU Compare to Deschutes?

Face it: Slot 1 Deschutes makes your system look like an Easy Bake Oven. But just how powerful have Intel CPUs become? Below, we've listed the highest bootMark scores we've ever seen generated by the various Intel processors. Please note each CPU was tested in a different system configuration, and the scores aren't necessarily the highest possible for each CPU and core clock speed.

The bootMark, designed by Symantec, simulates a typical real-world workload, taking into account more than 100 factors that affect system performance. The benchmark puts major stress on the CPU, including its bus interface, the transfer rate between memory and the CPU, the motherboard core-logic chipset, and the memory cache—both the built-in (L1) cache and the secondary (L2) cache. The benchmark emulates the processing instructions Windows 32-bit applications commonly use.

Because the benchmark emphasizes how effectively the system uses the CPU in conjunction with system memory, it doesn't take into account factors such as disk drives, the video display and other peripherals. The big performance jump you see when moving from a Socket 7 Pentium MMX to the Slot 1 Pentium II is primarily due to the Pentium II's close-coupling of the L2 cache, faster SDRAM memory in many P-II systems, better core-logic chipsets, and other factors.

While Pentium owners might find some of the numbers disheartening, they shouldn't freak out. A Pentium 200MHz MMX teamed with a 3Dfx card still makes a damn fine gaming machine, and no one needs a 333MHz processor to surf the Internet.



*score from Intel's web site
**score derived by overclocking a 333MHz to 416MHz
***projected score with 2MB L2 cache

The Dark Art of Overclocking

How to turn up the heat in your surging Pentium II

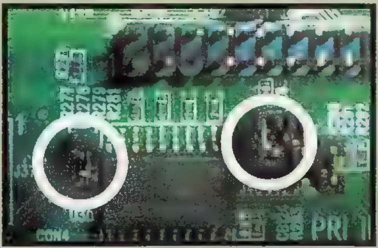
Deschutes country is home to majestic benchmarking plateaus and breath-taking code-crunching vistas. But if you probe deeper into the seemingly pure Pentium II outback, you'll find a foreboding underbelly—the quasi-mystical realm where PC alchemists practice the dark art of overclocking.

Imagine increasing your core processor speed from 333MHz to 416MHz with just a few motherboard jumper tweaks. It seems like magic, yes—but it can be done. While Intel doesn't officially deny the existence of the dark art, it does adamantly, vehemently, zealously discourage its practice. To wit: **The extra heat generated by overclocking can destroy your CPU.** *Neither Intel nor any equipment manufacturer on the face of this earth will honor your warranty should you fry your system while attempting to increase the speed of your processor. Likewise,* boot *will assume no responsibility for any fried, fused, or melted lumps of silicon. We are simply providing insight into overclocking so that you may learn more about the mysterious world around you.*

If you haven't run off yet, then let's descend into the dark realm.

Step 1) Rid yourself of destructive static electricity. This is a no-brainer, so crack open your computer case and discharge those stray electrons by touching your power supply casing (with the plug still connected).

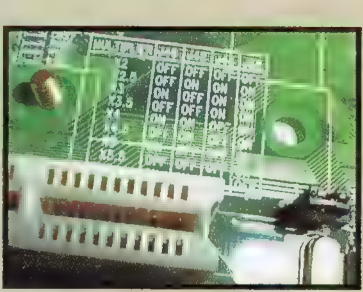
Step 2) Consider your cooling scenario. Most P-IIs already have some type of cooling system installed. It can be either passive (a heatsink attached to the processor) or active (a fan directed at the processor or a fan installed directly in the heatsink). If you successfully overclock your P-II, pay close attention to the stability of your system and start thinking about ways to improve air circulation inside your case. This may involve installing more fans. And always keep your case tightly closed—the vacuum helps ensure more efficient air flow.



Step 3) Locate the jumper settings for your motherboard. Regardless of whether your motherboard uses physical jumpers, DIP switches, or "soft jumpers" (adjustments found in your system BIOS), you'll have either a single setting that sets overall speed or two separate settings: one for system-bus speed and the other for the multiplier. By multiplying your bus speed by the multiplier setting, you can determine what type of speeds you can squeeze out. Before you make any adjustments, write down your current settings configuration. If some act of nature causes your system to crash after adjustment, you'd better have your original settings ready.

Step 4) Bust out your motherboard's instruction booklet and find the jumper settings for CPU speed. You may also be able to find your settings written on the motherboard. Now adjust your jumper settings to go one "bin" up from your processor's rated speed.

For example, if you have a 233MHz P-II, set your jumper configuration for 266MHz. How you do this will depend greatly on which motherboard you have.

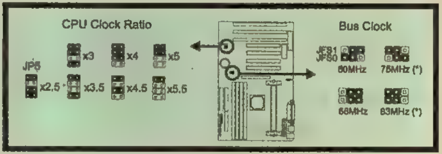


If you just have simple speed settings (233MHz, 266MHz, etc.), configure the speed up only one bin. If your motherboard uses the multiplier method, it should be currently set to 66MHz x 3.5 (that is, the speed of the system bus times 3.5). To go up a bin, set it to 66MHz x 4 (you'll hit 264MHz). If you have "soft jumpers," set the BIOS for either 266MHz or 66x4.

Initially go with a modest .5x bin jump to stay on the safe side.

Step 5) Power up your system and note the CPU speed during boot-up and POSTing. It should report that a P-II running one bin up is installed. If not, power down, double-check your settings, and try again. If the system refuses to POST or can't boot into Win95, something's not right and you should return your system to its original settings and call it a day.

Step 6) Are you in Windows 95? Great! Run your benchmarks and favorite applications to check for stability. Look for anything out of the norm: lock-ups, crashes, and visual glitches (cursor trails, icons dropping out, or patches of corrupted screen real-estate). If you're experiencing more grief than you did before your overclocking escapades, then you may need to take off your wizard's hat and restore your original settings.



Step 7) Explore other bus speed venues—75MHz and 83MHz. Check to see if your motherboard has the ability to use higher system-bus speeds. If not, then you're ass-out. But if you are granted access to faster realms, pick a speedier system-bus speed and go back to Step 2. Repeat the process using your faster system bus as your basis of overclocking.

Pay close attention to your system if you have an AGP card, as it will be affected by this particular overclocking method. If 3D-accelerated games that take advantage of AGP start acting weird, your AGP card isn't happy with the speeds.

Here's a little chart for those of you who do have 75MHz and 83MHz system-bus options and need a quick reference of speeds.

Bus speed x multiplier	CPU speed
75MHz x 3.5	262.5MHz
75MHz x 4	300MHz
75MHz x 4.5	337.5MHz
75MHz x 5	375MHz
83MHz x 3	249MHz
83MHz x 3.5	290.5MHz
83MHz x 4	332MHz
83MHz x 4.5	373.5MHz
83MHz x 5	415MHz

just two Slot 1 processors onto either formfactor. With the increase in CPU size, many motherboard makers plan on testing their parts in large tower cases. The boards will most likely be OEM-type server units.

Intel's offerings won't be the only core-logic chipsets in Deschutes country. VIA's VT82C680 Apollo P6/97 is almost ready to buddy up with Slot 1 processors, but it won't support AGP, making it more of a competitor to Intel's 440FX than anything. SiS, meanwhile, is preparing its own lil' surprise with the SiS 5601 AGPset. Exact specifications on the SiS 5601 are still cloudy, but it should share sister chipset SiS 5602's attributes, including support for up to 512MB of system memory, Ultra ATA/DMA, USB, and at least a 66MHz system bus. Other core-logic chipsets—such as Micron's own Samurai PCIset and Reliance Computer Corp.'s proprietary chipset seen in Compaq's workstations—will still be players in the game, but expect Intel to dominate the Slot 1/Slot 2 realm with an iron fist.

Has Intel Hardwired the Fun Out of CPUs?

With AMD hinting at 500MHz of screaming glory in the K7 processors due out in 1999, Pentium II owners might get jealous. So is there room to overclock extra oomph from Intel parts? We've all heard reports that Intel has recently engineered protection into its processors by not bonding one of the multiplier pins during the manufacturing process. This would allow the processor to effectively ignore higher clock speed settings, unless you overclock by pushing up the system-bus speed.

Well, some protection *seemed* to be in place when we played with a good old 233MHz Pentium II. Although we were able to push it up one speed to 266MHz (66x4), when we pushed it up to 300MHz (66x4.5) it refused to recognize it was set that way and reported that we had a 266MHz processor installed. However, if we jumpered the puppy up to 291MHz (83x3.5), the system fired up fine and benchmarked appropriately.

So how would a newer CPU perform? With a 333MHz Deschutes, Tekram P6L40-A4 motherboard, and 4MB ATI XPERT@play AGP card, we decided to go jumper-crazy and overclock away. We first configured the motherboard to 366MHz (66x5.5), and the system booted and ran just fine. Our bootMark posted an average score of 176.5—well above the average bootMark posted by the 333MHz Deschutes-fueled NEC Direction reviewed in this issue.

We next pushed the envelope to 412.5MHz (75x5.5) and the system seemed to be stable enough, posting an incredible average bootMark score of 195.2. Pushing past 75MHz and into the 83MHz realm, we reconfigured the system again, this time for 416MHz, and once again the system booted and allowed us to run amok. bootMark scores edged closer to the magical 200 mark by posting an average score of 198.

At these speeds, however, the processor heated up and the stability of the system was compromised. If you do decide to tread these grounds, you *must* cool down your processor in a serious way, as well as observe your system for long-term reliability. If you encounter intermittent lock-ups, crashes, or graphical glitches after pushing your CPU up one bin (the industry term for overclocking), you'd best ease up and rethink your optimization strategy. While we discovered protection wasn't in place in the parts we tested, we know first-hand that Intel frowns upon overclocking and will *not* honor any warranty if your CPU takes a dump during system-bus speeding exploits.

Where Do You Want to Go Tomorrow?

While the majority of 333MHz processors will go to the big system manufacturers, you should still be able to order individual CPUs from online stores or your friendly neighborhood computer mart by the time you read this. Prices will open at $919, but expect the usual price drops as Intel manipulates its pricing structures.

Slot 2 paraphernalia won't hit the streets until the third quarter of this year. And the parts will be expensive as hell.

So what minimum level of CPU performance should you accept in 1998? Intel seems to know what you want. As Dracott says, "For the *boot* reader, the power monger, 333MHz in Q1, 400MHz in Q2, and 450MHz for Q4."

If you were hoping for MMX2, Intel's much-ballyhooed 3D-extension instruction set, you'll have to wait until the next-generation Katmai processor rears its head sometime in early 1999—if you're lucky. Until then, Deschutes is where the power party is at, and it's up to you to grab an oar and shoot the rip-roaring rapids. ■

pentium II
PROCESSOR
intel

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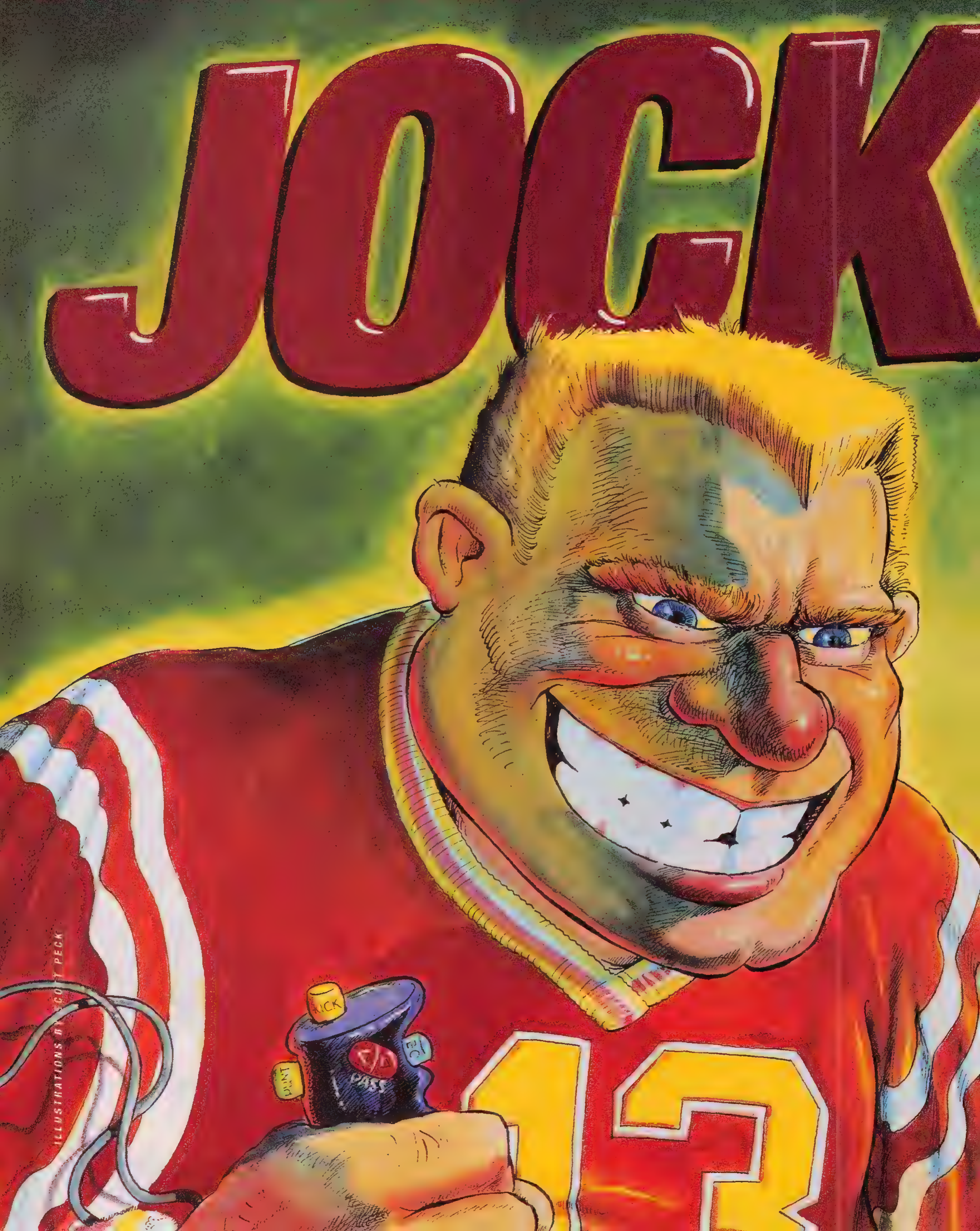
Product Information Number 372


JOCK
KICK
PUNT
PASS
BC
13

ILLUSTRATIONS BY SCOTT PECK

ITCH

So you got a bum knee. So what. A little ACL damage doesn't mean you can't stick your glutes in the angle of a comfy desk chair, fire up the old PC, and throw a few Hail Mary's to the boys in the end zone. That's right, baby, you've got the jock itch, and if you don't scratch it, it'll drive you nuts. Luckily, spring is the season of sports sims, and we've got scouting reports on all the big-name players you've been hearing about. Football, baseball, soccer, racing, hoops. So go ahead, manipulate the little guys. Boss 'em around. Show 'em the meaning of discipline. Sports sims are for armchair quarterbacks, not sniveling wimps.

—Michael Ryan

>

MADDEN NFL 98

TRY IT ON THE DISC

CHECKLIST

Madden NFL 98
Version: 1.1

Maximum Resolution/Color
640x480/8-bit

Win95 Native

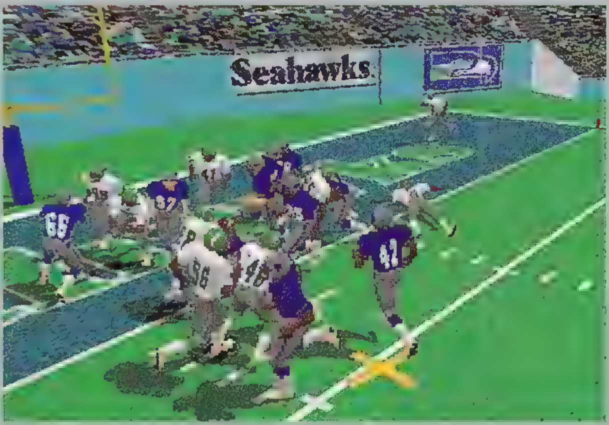
3D Acceleration
Direct3D

Native 3D Hardware Support
3Dfx Glide

DirectX
DirectDraw DirectSound
DirectPlay DirectInput

Multiplayer
LAN Modem Direct/serial

Specialty Controllers
Gravis Grip
Win95 compatible



Player animations and field art are easily the best in the category.

The *Madden* 1998 campaign includes more coaching and management options than ever, but is still an arcade-style game to the core. Gameplay is a bit quirky, and the code seems somewhat sloppy in spots, but *Madden NFL 98* is clearly the best overall football game in this year's pack.

Fully licensed by both the NFL and Players' Association, *Madden* uses 2D sprites and 3D polygon-based stadiums. The player animations are the best in this roundup, with ball-carriers hurdling would-be tacklers, high-stepping into the end zone, and crumbling dramatically when they're hit. The 3Dfx patch doesn't add all the bells and whistles you might expect, but the filtering helps clean up the player and field graphics. The 3D stadium rendering is also sped up, resulting in better frame rates. As always, the *Madden* sound effects add a realistic smash-mouth dimension. Unless you're an old *Madden* veteran, passing can be dangerous on anything but Rookie difficulty, as your receivers will rarely catch the ball. The AI remains suspect in some areas. A typical glitch: There's 15 seconds left in a tie game, and the computer has the ball on your 16-yard line with no time outs. But instead of kicking a game-winning field goal, it runs right up the middle and you go into OT.

Without the 3Dfx patch, Madden's weather effects are pretty plain.

The game has other flaws. Fumbles are often referred to as incomplete passes and receivers often go from being wide-open to being surrounded by as many as seven defenders in seconds. EA's action is far from perfect, but given the competition, *Madden* is still the best football title you'll play this season.

Price *$50*
Developer *Stormfront*
Publisher *EA*
Phone *800.425.4525*
URL *www.easports.com*

boot verdict 7

LEGENDS FOOTBALL '98

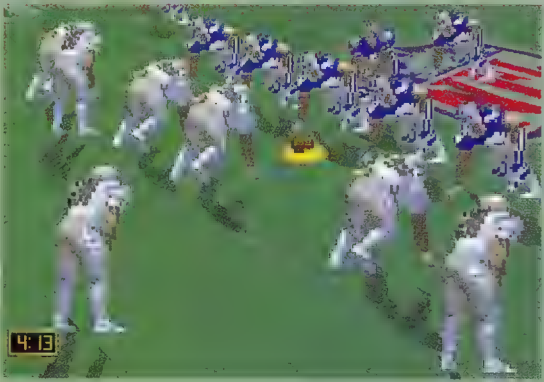
TRY IT ON THE DISC

If the idea of matching up the 1997 49ers with the 1968 Packers makes you drool, you'll get a kick out of Accolade's *Legends Football '98*. With more than 80 teams from four different eras, *Legends* has the potential to be a niche favorite among die-hard gridiron freaks. Unfortunately, even hard-core Lombardites won't be able to look past the game's antiquated graphics engine and poor gameplay.

Using a single difficulty level, the game is fully licensed by the NFL and the Players' Association and includes each of the 30 current NFL teams. You also get 50 classic teams from 1932, 1950, and 1968. The opportunity to line up teams from different eras is intriguing, as is the option to use old-time football rules. Sadly, most of the game's other aspects are disappointing or just plain awful. The graphics engine—which uses chunky, 2D sprites—is the worst of the roundup. Although the stadiums are fairly well-rendered in 3D, the player animations are has-been and glide over the turf like Kenny and Kyle glide through an episode of *South Park*. And all the players in the game have the same number (it looks vaguely like 88).

Running the ball is straightforward, but passing is poorly implemented: You must remember each receiver's pattern from the play selection screen.

League play and management options are *Legends* only saving graces. The career mode is something *Madden* has always lacked, and the ability to draft is very cool. In fact, it's these features—combined with the old-time teams and rules—that protect *Legends* from an even lower score.



These teams look something like the Seahawks and Raiders, but it's hard to tell through the sea of pixels.

The weather effects in Legends 98 *are pretty cool—except for the occasional glitch in field tiles, that is.*

CHECKLIST

Legends Football '98
Version: 1.2

Maximum Resolution/Color
640x480/8-bit

Win95 Native

DirectX
DirectDraw

Specialty Controllers
Gravis Grip
Win95 compatible

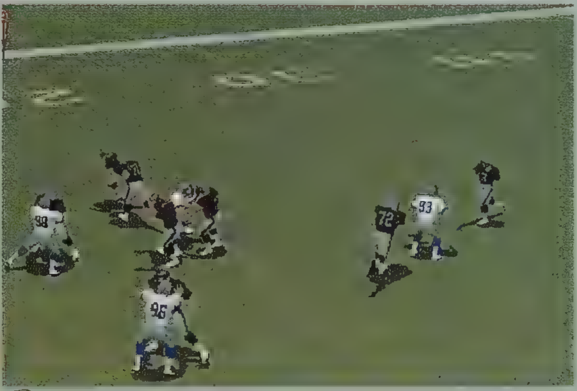
Price *$40*
Developer *Saffire Corp.*
Publisher *Accolade Inc.*
Phone *800.245.7744*
URL *www.accolade.com*

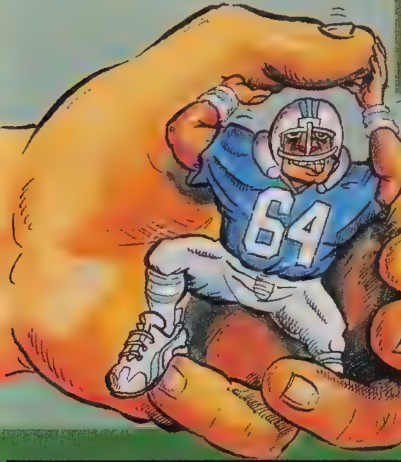
boot verdict 4

FRONT PAGE SPORTS: FOOTBALL PRO '98

FPS Football Pro 98, like its predecessors, is the best title for simulating the strategic maneuvering of coaches and GMs. The game's only real problems are poor graphics and gameplay—it simply isn't any fun.

Unlike previous versions, *Football Pro '98* is a full-screen application. The 2D graphics are crisp and clean, with good player animations.


The player animations in FPS 98 *are good, but the gameplay isn't.*



Unfortunately, they pale in comparison to *Madden*, and players glide over the field almost as poorly as those in *Legends '98.* The playcalling menu is confusing, and unchanged from the awkward menu system that Sierra has used for years. You can customize camera angles during play, and you almost have to since most of the defaults are poor. The gameplay itself is slow and boring, and while the game's controls are easy enough to master, you're better off letting the computer run plays for you.

League play and management options are the title's strength, but even these features are hampered by layer after layer of menus and dialog boxes that stand between you and a simple trade. The game's only near-perfect feature is the play editor, which remains unsurpassed.

CHECKLIST

Football Pro '98
Version: 1.02

Maximum Resolution/Color
640x480/8-bit

Win95 Native

WinNT Compatible

DirectX
DirectDraw DirectSound
DirectPlay

Multiplayer
LAN Modem
Direct/serial TCP/IP

Price *$30*
Company *Sierra On-Line*
Phone *800.757.7707*
URL *www.sierra.com*

boot verdict 5

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Product Information Number 372

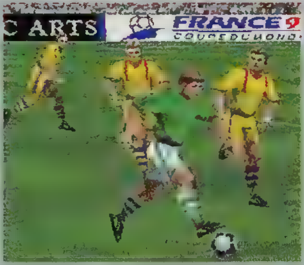
boot KICK ASS! PRODUCT

FIFA ROAD TO WORLD CUP 98

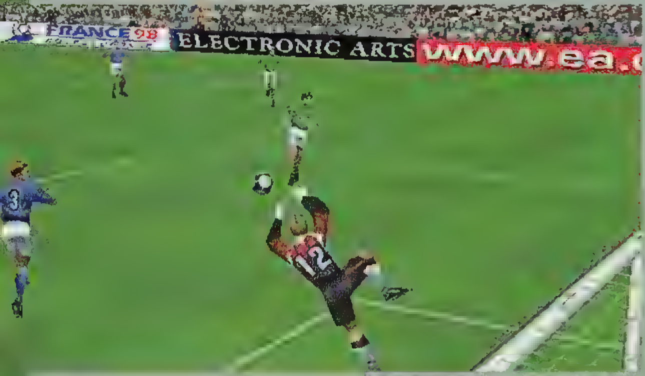
TRY IT ON THE DISC

Electronic Arts has given us a number of great sports games this year, but *FIFA Road to World Cup 98* blows them all away. This gorgeous title has the gameplay, graphics, and depth to please any sports fan.

FIFA 98 includes a staggering 189 teams from around the world and lets you play a full-blown World Cup tournament from the qualifying round on. The 3D engine is spectacular—easily the best yet from EA Sports and light years ahead of *Worldwide Soccer.* Even without 3D acceleration, the game looks great and plays smoothly on a P166. With 3D acceleration enabled, *FIFA 98* is without equal. The stadiums are well rendered, the field looks realistic, and player animations are exquisite.



The Irish juggernaut rolls on.



The detail level in the field, the animations, and the players are astounding.

Moves such as bicycle kicks, volleys, and slide tackles look perfect. Post-goal celebrations are particularly impressive—especially when scorers gyrate before falling on their backs. The game's Scottish color commentator can also be very humorous. You might expect the game to fall flat on gameplay, but even here *FIFA 98* is without a peer. Most commands are single-button affairs, but the game also lets you use more intricate controls to perform special plays.

There simply isn't much to dislike about *FIFA 98*, except maybe the skimpy camera controls on the replay feature and the fact that about half of the gameplay camera angles are poor. Still, these are minor complaints. If you have any interest at all in a soccer game for your PC, this is the only one to get.

Price *$50*
Developer *EA Sports*
Publisher *EA*
Phone *800.425.4525*
URL *www.easports.com*

boot verdict 9

CHECKLIST

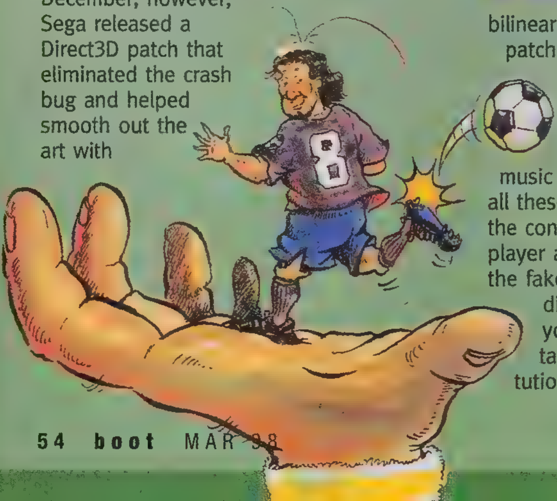
FIFA Road to World Cup 98
Version: 1.0

Maximum Resolution/Color
640x480/16-bit
Win95 Native
Native 3D Hardware Support
3Dfx Glide PowerVR
DirectX
DirectDraw DirectSound
DirectInput
Multiplayer
LAN Modem Direct/serial
Specialty Controllers
Gravis Grip
Win95 compatible

WORLDWIDE SOCCER

Despite the cheesy, arcade-style atmosphere and lackluster look and feel, Sega's *Worldwide Soccer* is a decent game. But it's not half the game *FIFA 98* is, and this is a problem.

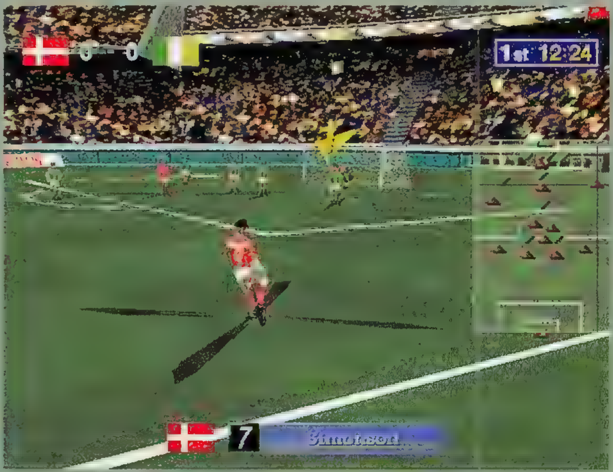
Worldwide Soccer isn't licensed by FIFA (the Fédération Internationale de Football Association), but does include 48 generic international squads. The original release didn't support 3D acceleration. While the game's software 3D engine ran smoothly on a moderately equipped P166, it crashed constantly and looked amateurish. In December, however, Sega released a Direct3D patch that eliminated the crash bug and helped smooth out the art with bilinear filtering. But the patch also added visible texture seams and players who become orphaned against the sky when the camera rotates to field level. The game's music and menus are terrible, but despite all these problems, gameplay is solid and the controls can be learned in minutes. The player animations are excellent, especially the fake injury acts that accompany each dirty slide tackle. You can customize your team's field alignment and tactics, as well as make player substitutions. With the patch installed, this is a decent soccer game. But since *Worldwide Soccer* doesn't execute better than *FIFA 98* in any category, it's difficult to give it a passing grade.



CHECKLIST

Worldwide Soccer
Version: 1.0

Maximum Resolution/Color
640x480/16-bit
Win95 Native
WinNT Compatible
DirectX
DirectDraw DirectSound
DirectPlay DirectInput
Multiplayer
LAN Modem
Direct/serial TCP/IP



Worldwide Soccer's "radar" window can be very helpful for keeping track of your team's positioning.

Price *$40*
Developer *Sega of Japan*
Publisher *Sega Entertainment*
Phone *800.872.7342*
URL *www.sega.com*

boot verdict 5

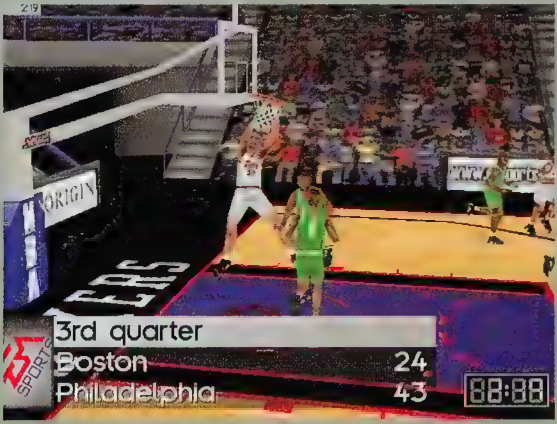
NBA LIVE 98

NBA Live 98 isn't as perfect as EA's *FIFA*, but it's the best thing going in computer hoops. The excellent 3D engine is similar to the one used by *NHL 98*. The 3D-rendered stadiums are identical to each other, but each team's home-court floor is incredibly detailed. The polygonal players don't look quite as polished as their *NHL 98* and *FIFA 98* cousins, but the player animations are top-notch, particularly the elaborate dunks, which number more than 30. Other great animations include complex fade-aways, layups, and leaning jump shots.

The graphics engine has one glitch that's been plaguing *NBA Live* since 1995: Players seem to float over the surface of the floor. This is especially noticeable in 3Dfx mode. We were also disturbed by the insanely grinning players' real-life league photos over their polygonal blockheads.

Though the game runs fine on an unaccelerated P166, the 3Dfx mode adds bilinear filtering and a higher frame rate.

NBA Live 98's only major flaw is suspect AI. Even on the hardest of four difficulty levels, we were able to beat the computer almost every time by 15 or more points. We averaged 17 steals per game, while the closest computer-controlled team averaged only three. Regardless, this is the best basketball game around. The GM draft alone may be reason enough to buy this title.



Holy absent AI! The 76ers ahead by 19 in the second half?!

CHECKLIST

NBA Live 98
Version: 1.1

Maximum Resolution/Color
640x480/16-bit

Win95 Native

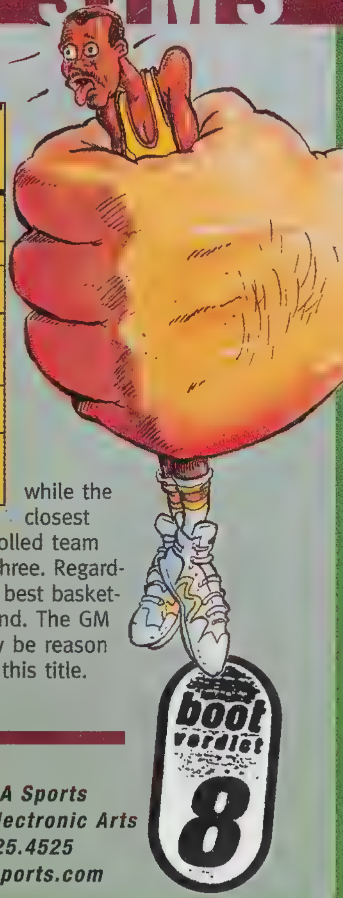
Native 3D Hardware Support
3Dfx GLIDE

DirectX
DirectDraw DirectSound
DirectInput

Multiplayer
LAN Modem Direct/serial

Specialty Controllers
Gravis Grip
Win95 compatible

Price *$50*
Developer *EA Sports*
Publisher *Electronic Arts*
Phone *800.425.4525*
URL *www.easports.com*



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by 3Dfx.

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Product Information Number 372

NBA ACTION 98

TRY IT ON THE DISC

NBA Action 98 is a solid game with decent graphics and good gameplay. While it's not as good overall as *NBA Live 98*, it doesn't miss by much.

The game didn't support 3D acceleration at the time of this writing (a patch should be ready by the time you read this), and its graphics, while good, just can't compare to a 3Dfx-enhanced *NBA Live 98*. The game runs at 320x240 and 640x480 in 8- or 16-bit color at either resolution. Trust us—you don't want to play low-res. Even at high-res, the graphics are just chunky enough to hinder gameplay. It's often difficult to judge your player's position in relation to other players, which makes it easy to miss plays and run out of bounds. Player graphics are fairly well-detailed and the animations are good, but the players tend to blend together on-screen. The court and crowd art are good, but who cares when you've lost Tim Hardaway in a pile of pixels?

The AI, however, is impressive. We were

CHECKLIST

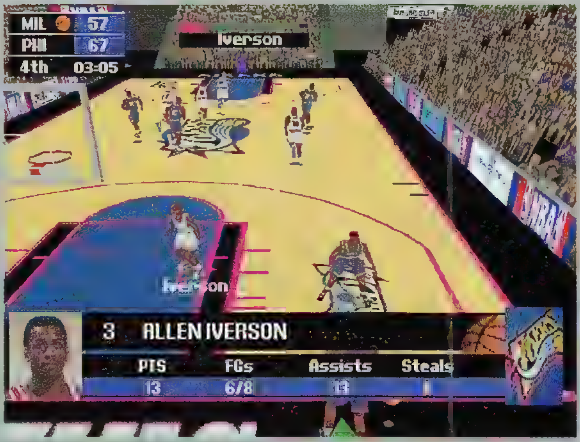
NBA Action 98
Version: 1.0

Maximum Resolution/Color
640x480/16-bit

Win95 Native

DirectX
DirectDraw
DirectSound
DirectPlay
DirectInput

Specialty Controllers
Gravis Grip
Win95 compatible



The court detail is very good in NBA Action 98*—definitely on par with* NBA Live 98.

VR BASEBALL

TRY IT ON THE DISC

With a supposedly revolutionary graphics engine and a hardware acceleration requirement, VR Sports' *VR Baseball* comes to the plate with plenty of swagger. But if you think this is the Next Big Thing in simulated baseball, think again. You'll need a 3D accelerator to get busy, and we're not talking ViRGE. Compatible chipsets are 3Dfx Voodoo, Rendition V1000 and V2200, and ATI 3D Rage Pro.

CHECKLIST

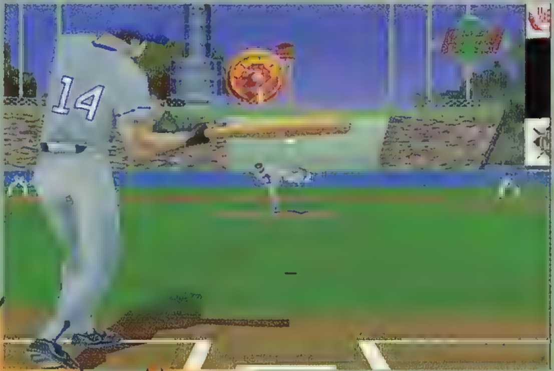
VR Baseball
Version: 1.0

Maximum Resolution/Color
640x480/16-bit

Win95 Native

3D Acceleration
Direct3D

DirectX
DirectDraw
DirectSound
DirectInput



The stadium art is fantastic, but the players are not nearly as impressive.

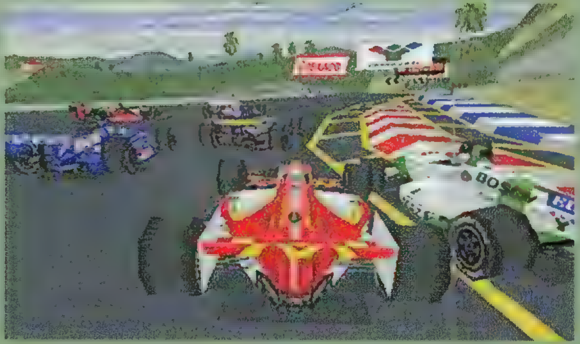
But even with hardware behind it, *VR Baseball* comes up short in the graphics department. The players are cobbled together out of poorly sculpted polygons—each one looks like a tall hunchback. The player texture maps are average at best, and the faces look awful. Thankfully, the stadiums are remarkably well rendered, and the field looks great, with nicely filtered grass and dirt borders. Most player animations are excellent, but the transitions between them are harsh or just plain missing. For example, players who strike out swinging actually look the part—they lose their balance or step too far into the swing. But then they erupt into an awkward, crouched run toward the dugout that ruins the realism.

ANDRETTI RACING

TRY IT ON THE DISC

EA's latest racing game is a lot of fun and offers great visuals, but it tries too hard to straddle the line between arcade and simulation.

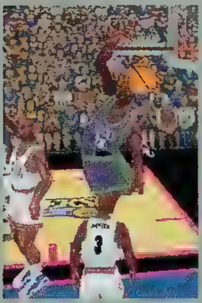
Andretti Racing doesn't appear to be licensed by anything other than the Andretti family, but it does have 16 authentic tracks, including Indy Car courses and a handful of NASCAR-style ovals. The graphics engine is strong, though not quite as eye-popping as *F1 Racing Simulation. Andretti* supports Direct3D acceleration, which provides nicely filtered textures and lens flare effects. The frame rate increases, too, but since the game runs smoothly on moderately equipped machines without acceleration, the improved rates will be most noticeable on slower systems. Distance rendering, which is so important in driving games, is average, though the optional fogging effect can help mask flaws. The game also lets you adjust the target frame rate, which can vary between 15 and 30. The tracks are challenging, well rendered,



Andretti *offers a good level of detail and some nicely modeled cars.*

hard-pressed to beat the computer at the highest of three difficulty levels, and even the lowest level offered a decent challenge. The computer sets up effective defenses and makes passing difficult.

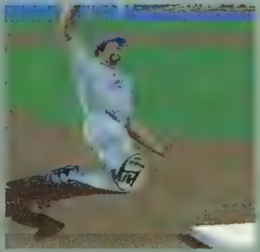
NBA Action 98 revealed a few annoying bugs during testing. The game refused to let us call a timeout—the option was grayed out despite the fact that the NBA rule book was on our side. Nor would the game let us sub players during AI timeouts. Nonetheless, *NBA Action 98* is an inspired effort to topple EA's hoops champ. With a few tweaks and some graphic enhancements—bilinear filtering is a must—this game could become a serious contender.


How can he dunk like that with no legs?

Price $40
Developer Visual Concepts
Publisher Sega Entertainment
Phone 800.872.7342
URL www.sega.com

boot verdict 6

Gameplay is decent, but not up to *Triple Play 98* standards (see review in *boot* 12). Pitching, fielding, and batting controls are extraordinarily easy to master. The camera angles are lousy, however, and that makes hitting a challenge. Though the game boasts numerous viewpoints, the camera only tracks a handful of the action. The rest of the time you're staring at an inactive fielder or, even more puzzling, the stadium roof. *VR Baseball* isn't a bad game, but if you want a cool-looking, arcade-style baseball game you should go with *Triple Play 98*, the best of the baseball brethren.


The game does include some nice touches, like the shadows and the bottom of this guy's cleats.

Price $40
Developer Digital VooDoo
Publisher VR Sports/ Interplay
Phone 800.468.3775
URL www.vrsports.com

boot verdict 5

and just as detailed outside the course as they are on the road. For example, the track in Rome, Georgia, is bordered by elaborate columns and arches. *Andretti* has solid AI, but it's nothing you can't defeat with a little practice. Your biggest challenge will be to keep from spinning out; the car physics could be much more forgiving. If you approach *Andretti* as an arcade racer, you'll almost certainly enjoy it.

CHECKLIST

Andretti Racing
Version: 1.0

Maximum Resolution/Color
640x480/16-bit

Win95 Native

3D Acceleration
Direct3D

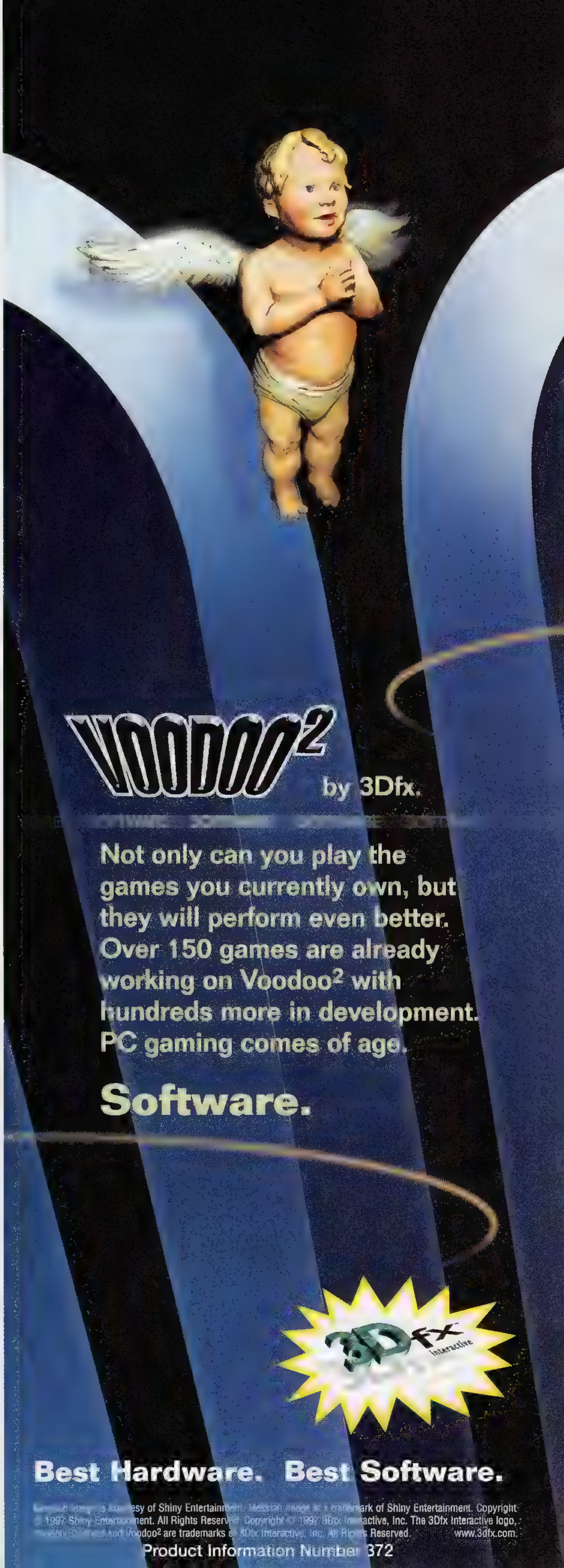
DirectX
DirectDraw DirectSound
DirectPlay DirectInput

Multiplayer
LAN Modem Direct/serial

Specialty Controllers
Force feedback Gravis Grip
Win95 compatible Throttle

Price $50
Developer EA Sports
Publisher EA
Phone 800.425.4525
URL www.easports.com

boot verdict 6



Not only can you play the games you currently own, but they will perform even better. Over 150 games are already working on Voodoo² with hundreds more in development. PC gaming comes of age.

Software.

Best Hardware. Best Software.

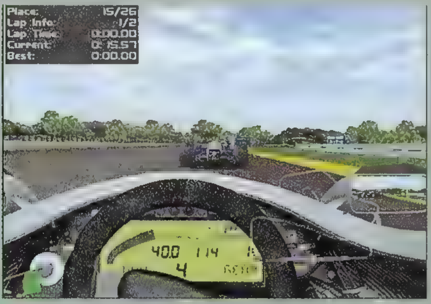
[illegible] courtesy of Shiny Entertainment. [illegible] trademark of Shiny Entertainment. Copyright © 1997 Shiny Entertainment. All Rights Reserved. Copyright © 1997 3Dfx Interactive, Inc. The 3Dfx Interactive logo, [illegible] and Voodoo² are trademarks of 3Dfx Interactive, Inc. All Rights Reserved. www.3dfx.com.

Product Information Number 372

CART PRECISION RACING

With good gameplay, nice graphics, and tons of customizable features, *CART Precision Racing* could be one of Microsoft's best games to date. Fully licensed by Championship Auto Racing Teams (CART), *Precision Racing* offers 17 authentic tracks from the CART World Series circuit. You'll need a Direct3D accelerator to see it at its best. Unaccelerated, the game ran sluggishly on a decked-out P166. Using 3Dfx acceleration, the game looked and ran much better—with at least double the frame rate. *Precision Racing* makes effective use of filtering to smooth textures, but if there was ever a game in need of fogging, this is it. The objects popping into view on the horizon are an especially ugly sight—even with distance rendering set to maximum.

The game offers some unique effects, such as a head-panning feature that shifts your viewpoint to either side when you enter a curve. The detail level is nice, with an exceptional cockpit graphic and well-rendered cars. The tracks themselves are challenging and car physics feel true-to-life. Fortunately, novice *CART* drivers can adjust the realism. You can also customize your car to improve handling. Even with adjustments, however, you might be hard-pressed to keep your car on the road. It's very easy to spin these babies out—especially when the game throws rain at you. The game also includes a Racing School, and a multitude of stats and driving analysis tools. It's quite an impressive package for anyone interested in a good-looking, realistic driving sim. Just make sure you have a 3D accelerator and a good controller handy.

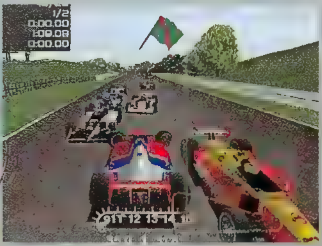


CART's head-panning feature slides the camera angle slightly on curves.

CHECKLIST

CART Precision Racing
Version: 1.0

Maximum Resolution/Color
640x480/32-bit
Win95 Native
WinNT Compatible
3D Acceleration
Direct3D
Native 3D Hardware Support
3Dfx GLIDE
DirectX
DirectDraw DirectSound
DirectPlay DirectInput
Multiplayer
LAN Modem Direct/serial
TCP/IP
Specialty Controllers
Force feedback Throttle
Win95 compatible
Steering Wheels



These idiots, don't they know they're going the wrong way?

Price $50
Developer Terminal Reality
Publisher Microsoft
Phone 800.426.9400
URL www.microsoft.com

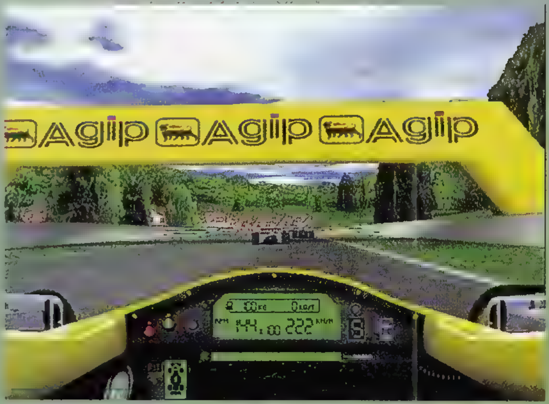
boot verdict 7

F1 RACING SIMULATION

boot KICK ASS! PRODUCT

If you're looking for a realistic racing sim with killer graphics, look no further than *F1 Racing Simulation.* Despite the uninspired name, this game has all the right ingredients to please novice and hard-core racing fans alike. *F1* includes 22 real drivers and 16 authentic tracks, and requires a 4MB 3D accelerator. The cars display an amazing level of detail, from the glowing tail lights to the racing team logos. Each course is rendered with painstaking finesse, with trees overhanging the roadway and shadows covering the track. Most of the tracks are extremely complex and some range up and down hills as well as through narrow streets. The rain effects are great, though not quite as impressive as Psygnosis' *Formula 1.* Fogging, distance rendering, and filtering are all well-implemented and the game flies along on a P166. The tracks are tough to master. Even in easy mode, you'll have a tough time handling some of the curves. The computer-controlled cars are intelligent, hanging back until you do something stupid, then zipping past you in alarming numbers.

Unfortunately, the version I reviewed (European release 1.05) locked up my system a few times and had a bizarre graphics bug that cut off the top of the dashboard (patches will be native in the Yankee version; they should address the bugs). Also, the background art was inconsistent, with some buildings and trees looking sloppy. These are minor points, however, and *F1 Racing Simulation* easily takes the checkered flag in this roundup.

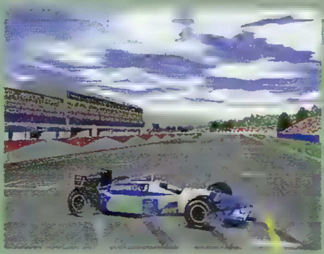


F1's attention to detail is staggering, as this cockpit view illustrates.

CHECKLIST

F1 Racing Simulation
Version: 1.05

Maximum Resolution/Color
640x480/16-bit
Win95 Native
3D Acceleration
Direct3D
Native 3D Hardware Support
3Dfx Glide
DirectX
DirectDraw DirectSound
DirectInput
Multiplayer
Direct/serial TCP/IP
Specialty Controllers
Force feedback



Even spin-outs look great in Ubi Soft's latest racing game.

Price $45
Company Ubi Soft
Phone 415.547.4000
URL www.ubisoft.com

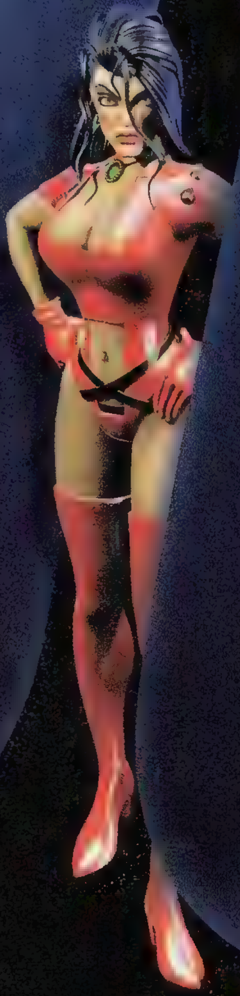
boot verdict 9

VOODOO^2 by 3Dfx.

VISUALS VISUALS VISUALS VISUALS

Benchmark this. A full suite of visual effects: tri-linear filtering, per-pixel MIP-mapping, transparency, fog, alpha blending, texture animation, Z-buffering and a host of other dynamic features – all without impairing performance. Death never looked so pretty.

Visuals.



3Dfx interactive

Best Hardware. Best Software.

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Product Information Number 372

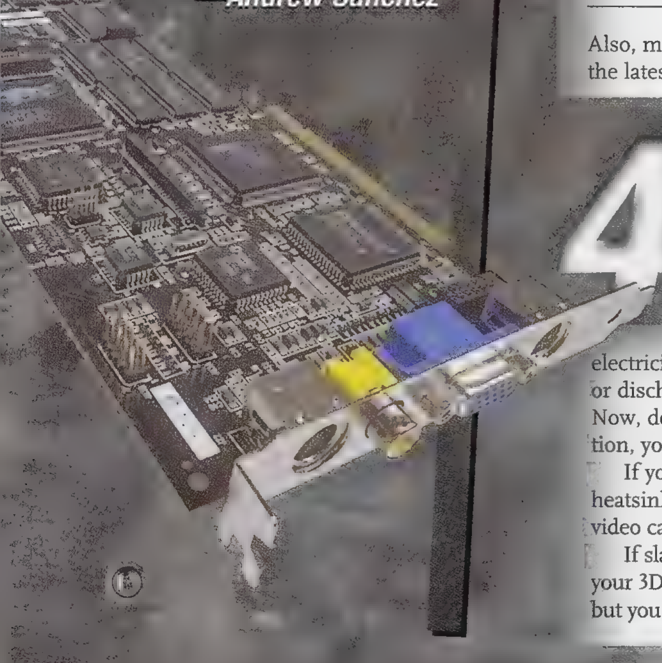
DEALING WITH YOUR **PC OBSESSION** DAY TO DAY BY BREAKING IT DOWN INTO 12 **EASY** STEPS

Overclocking Your 3Dfx Accelerator Card

TRY IT ON THE DISC

You've dabbled in the arcane art of overclocking your CPU, but can this magic be cast on your 3Dfx accelerator? Read on and learn the secrets of getting the extra performance you so rightly deserve. But be warned—what you're about to learn may get the 3Dfx Inquisition after you, so watch your step!

—Andrew Sanchez



1

Abandon All Hope Ye Who Enters

Before you even think about subjecting your 3D processor to the intense heat of overclocking, we have to give ye olde stern warning: *Overclocking anything will greatly increase the operating temperature of the processor in question.* This not only may result in intermittent lock-ups or visual glitches, but could destroy the processor outright. And to add insult to injury, *overclocking voids your video card's warranty*—if you melt your accelerator, you're up the creek without a paddle, Skippy.

We at *boot* take no responsibility for any sub-molecular mayhem overclocking may create.

You have been warned.

2

Getting Your Software Straight

Make sure you're armed with the latest versions of drivers and games. This may sound trivial, but many people forget about such details.

3Dfx	www.3dfx.com
Rendition	www.rendition.com
Diamond Multimedia	www.diamondmm.com
Orchid	www.orchid.com
Guillemot	www.guillemot.com
Hercules	www.hercules.com
RealVision	www.deltrontech.com/f3d.htm

Also, make sure you're running the latest version of Glide (2.43).

3

Setting Your Baseline For Comparison

Before you start experimenting with your 3D accelerator, now would be a good time to get some baseline frame-rate scores to see how much improvement you can squeeze from your cards. This is accomplished by running each game's appropriate benchmark or frame counter.

Testing should be done at 640x480 at full-screen, with no status bars visible. If you wish, try setting your gaming display at higher and lower resolutions (800x600 and 512x384) and take frame counts from there. We'll use 640x480 for this run-through.

- For *GLQuake*, use our own **bootmark.dem** file (located on the *boot*Disc) and invoke the benchmark by typing **timedemo bootmark** at the console. Make sure you hit the tilde key (˜) to clear the console from the screen.
- For *GLHexen 2*, use the **demo2.dem** file included on the final shipping version. Just as in *GLQuake*, invoke the benchmark by typing **timedemo demo2** at the console. Make sure you hit the tilde key (˜) to clear the console from the screen.
- For *Quake II*, the logistics for benchmarking are a bit different. We'll use the **demo2.dm2** file as the benchmark. To start benchmarking, you must pull down the console by hitting the tilde key, type **timedemo 1**, and hit return. Now, type in **demomap demo2.dm2** and hit return. If the console is still active when the benchmark starts, stop the run immediately by pressing the tilde key. Type in **demomap demo2.dm2** and press enter—this should clear the console. Or, you can type **map demo2.dm2**, and that will work, too.

Record all your scores.

For our example, we used Orchid's Righteous 3D slapped inside our resident reference Pentium II 300MHz Micron Millennia XRU system, but any Voodoo card will work.

Here are our initial results based on the default 50MHz setting.

GLQuake II	640x480	22.5fps
GLQuake	640x480	29.1fps
GLHexen 2	640x480	21.8fps

Once you're done with that, grab your Phillips screwdriver for a little hardware surgery.

4

Nudge-Nudge, Yank-Yank

We all know this one—power down your system, disconnect the necessary cables, and discharge any static electricity by either grounding yourself or discharging on the power supply. Now, depending on your cooling situation, you can go one of two routes.

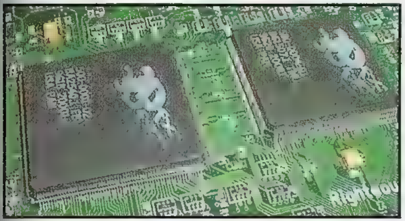
If you're hell-bent on slapping a heatsink on your 3D chip, remove the video card and go to Step 5.

If slapping a heatsink directly on your 3D processor gives you the willies but you still wanna chill, go to Step 6.

5

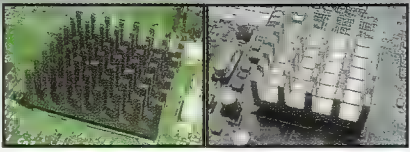
You Gotsta Chill

First of all, locate the processor in question. There are several ways you can go about cooling your overclocked 3D accelerator. One way is simply to attach a heatsink to your processor.



Getting a mini heatsink is easy—just go to any electronics hardware supply store, which should have something in stock to suit your needs.

Measurements for a Voodoo's texelFX chips are 1 1/8-inch square, while the pixelFX is 1 1/4-inch square. A heatsink should be about 1/8-inch bigger than the processor in question and should not stick out any more than 3/8-inch.



Attach the heatsinks to the texelFX and pixelFX chips with thermal glue.

There are two major problems with this method: 1) *Slapping a heatsink on a 3D accelerator that didn't ship with one will void your warranty—you've been warned.* 2) If you own a tower case, you should *not* use a heatsink. Why? Simple physics. Warm air rises, and since the PCI card sits upside-down when installed, all the heatsink will do is trap the heat, which will rise back through your 3D accelerator's processor, raising the temperature even higher than without the heatsink.

If you're *really* crazy and have a free ISA slot situated next to a PCI slot, you can get a massive PC fan cooler system that will circulate air inside your case. These twin-fan configurations run about $20 and push about 24.72 cu. ft./min worth of airflow. Or, go to Step 6 for an easier cooling solution.

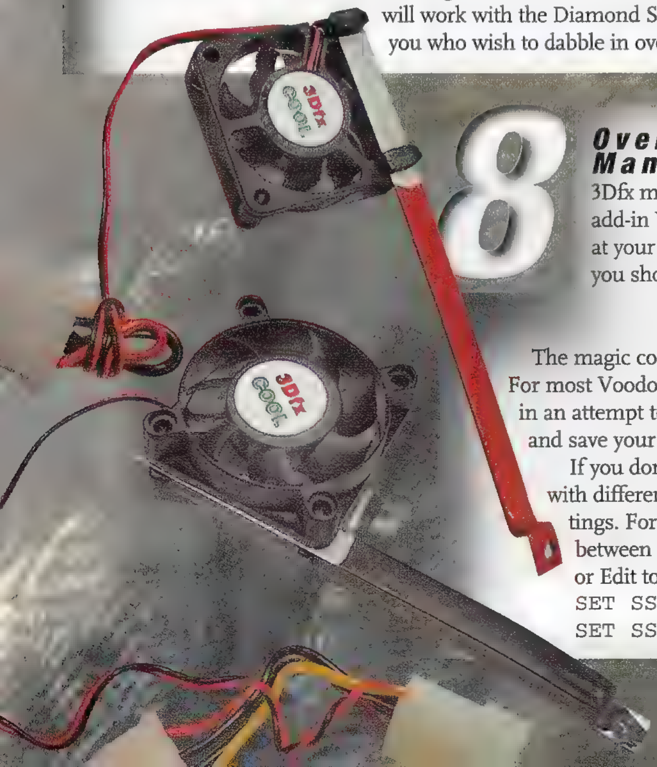
6

If Ya Wanna Blow, Just Let Me Know

What about if you want something simple, yet effective?

3DfxCool, a company out of Edmonds, WA, has solved the cooling problem by custom-engineering a fan and bracket combo that bolts onto Voodoo add-in boards. It also makes fans for Voodoo Rush–based boards and will even custom-make fan/bracket combos for your own specific setup. Take a peek at the goods at **www.3dfxcool.com** for more information and ordering.

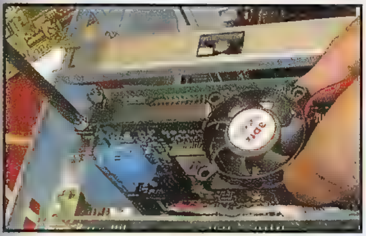
Here are two of 3DfxCool's offerings—the longer one is for Voodoo-based boards; the smaller one with the red rubber coating is for Voodoo Rush boards. Oh, the Voodoo fan will work with the Diamond Stealth II S220 for those of you who wish to dabble in overclocking your V2100....



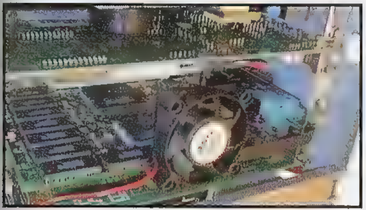
7

Feeling The Cool Breeze

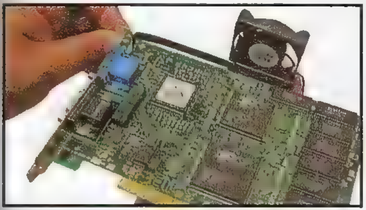
Installing the 3DfxCool fan is a snap—all you need to do is remove the screw holding your Voodoo card in place and position the fan in the following manner.



Now, put the screw through the hole and screw down the fan and your Voodoo card back into position.



The fan should now be placed right above both processors, sitting at a 90-degree angle.



The fan comes with a pass-thru molex power connector, so plug it into a nearby power cable and you're set to go.

Don't put that case back on just yet—you'll need to make sure the fan is working and the heat is being dissipated.

8

Overclocking: The Manual Method

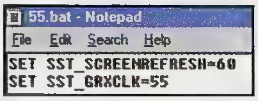
3Dfx made it easy to overclock an add-in Voodoo-based board. Look at your AUTOEXEC.BAT file—you should see the following lines:

```
SET FX_GLIDE_SWAPINTERVAL=1
SET SST_GRXCLK=50
```

The magic command in question is **SST_GRXCLK=**, which sets the Voodoo clock speed. For most Voodoo cards, 50 is the default setting, but you can change this to a higher speed in an attempt to squeeze that extra fps. Type in a higher number that doesn't exceed 60 and save your AUTOEXEC.BAT file.

If you don't want to overclock your 3D card all the time, you can either do a multi-boot with different autoexec settings or make your own batch file that simply has the new settings. For our tests, we made two batch files, 55.BAT and 57.BAT. The only difference between the two are the clock values. You can use Notepad or Edit to make them. 55.BAT contains the following lines:

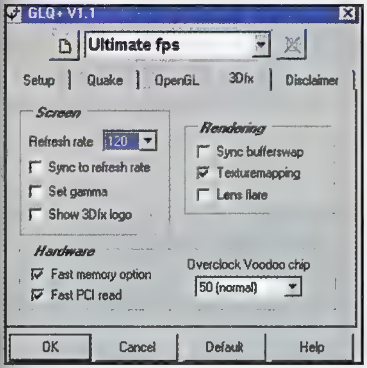
```
SET SST_SCREENREFRESH=60
SET SST_GRXCLK=55
```



```
SET SST_SCREENREFRESH=60
SET SST_GRXCLK=55
```

9 Overclocking: The Point-And-Click Way

A variety of Win95-native apps will allow you to tweak your Voodoo performance via a simple GUI interface. For the 3Dfx user, *GLQ+* is one option. This program is specifically designed for boosting performance for *GLQuake* and *GLHexen 2*.



Ultimate fps

Screen
Refresh rate: 120
☐ Sync to refresh rate
☐ Set gamma
☐ Show 3Dfx logo

Rendering
☐ Sync bufferswap
☑ Texturemapping
☐ Lens flare

Hardware
☑ Fast memory option
☑ Fast PCI read

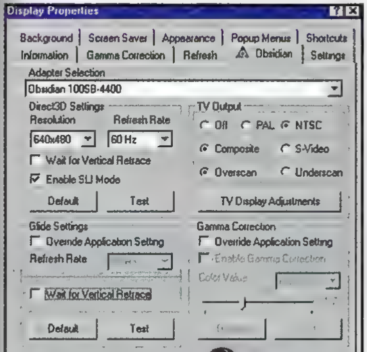
Overclock Voodoo chip: 50 (normal)

From here, you can monkey around with all sorts of options.

There are countless others out there, such as *Tweak Quake II* and *Tweak Rush*.

Take a walk to web sites such as Voodoo Extreme (**www.voodooextreme.com**).

Some Voodoo vendors actually give you the option to overclock your card within their control panels, including Canopus and Quantum3D.



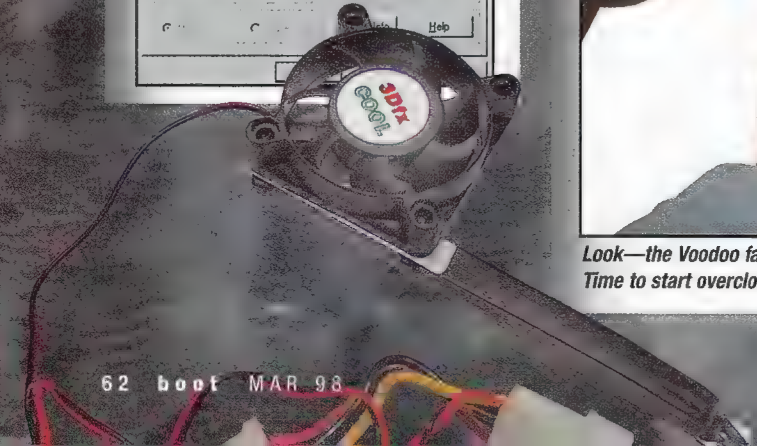
Adapter Selection: Obsidian 100SB-4400

Direct3D Settings
Resolution: 640x480
Refresh Rate: 60 Hz
☐ Wait for Vertical Retrace
☑ Enable SLI Mode

TV Output
○ Off ○ PAL ● NTSC
● Composite ○ S-Video
● Overscan ○ Underscan

Glide Settings
☐ Override Application Setting
Refresh Rate
☐ Wait for Vertical Retrace

Gamma Correction
☐ Override Application Setting
☐ Enable Gamma Correction
Color Value

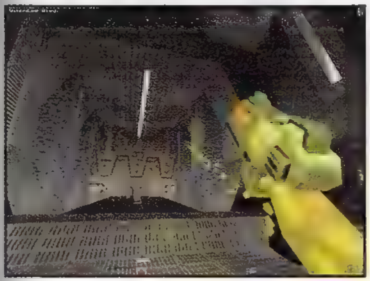


10 It's Time To Test

Now that you're back in Win95, it's time to start re-benchmarking your system for any performance improvements.

Make sure you're testing at the proper resolution and record your results.

Here are the new results based on a clock setting of 55MHz.



GLQuake II	640x480	25.0fps (+2.5fps)
GLQuake	640x480	31.9fps (+2.8fps)
GLHexen 2	640x480	23.1fps (+1.3fps)

By the simple act of changing one variable, you've accomplished a performance boost that's usually associated with a faster processor.

Wasn't that simple? Now, to the really fun stuff...

11 Adjust Settings; Re-test To Verify

Break out the Pepsi and start pumping those polygons. Are any of your applications locking up, experiencing weird visual glitches, or simply not working? Your 3Dfx card may not be able to handle the faster clock speed. If you encounter problems, you may need to set your clock speed back a megahertz or two by going back into your batch file and changing the number. Reboot your system and try running your apps again with the slower setting. Also, check on your fan or cooling system—is there enough air moving across the processors? How hot are they running? Many things can affect your system stability, such as video memory speed (the faster the memory, the lower likelihood of shearing), cooling, and others. The Righteous 3D has the slowest EDO DRAM among the Voodoo cards, while the Deltron Flash 3D has the fastest.

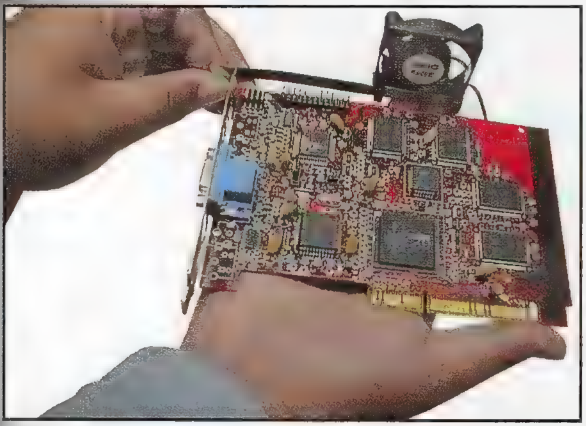
Benchmark and compare your results.

12 It's At Your Own Risk

Once you've discovered the magic of overclocking, it's hard to say no. But remember, the faster you push, the hotter your 3D accelerator will get, so proceed with caution. Your upper limit should be 57, but you can try 60 and see if your system is stable enough. You'll be entering extremely dangerous territory if you decide to forge ahead, as the Voodoo processor will heat up like hell and your performance will go up only marginally, making the risk less inviting.

Also, don't think Voodoo has the overclocking cartel—Rendition's V2100 and nVidia's Riva 128 can also be overclocked to get better performance.

But, that's another story...



Look—the Voodoo fan also works on a Rendition V2000 board! Time to start overclocking...

IRQS ACTING UP? VIDEO **DRIVERS** GETTING YOU **DOWN**? 3D CARDS HAVE YOU CAUGHT IN A **CONUNDRUM**? BOOT **EDITORS** ANSWER YOUR TOUGHEST **PC QUESTIONS**

My Linux Can Beat Up Your Linux

Your Linux 12-Step (*boot* 15) was great for those who haven't taken the plunge, but why did you decide to use Debian? Debian is certainly not the most popular distribution (that would be Slackware) or the overall best (that would be RedHat). Debian isn't really great at anything. RedHat would be my choice, because of the abundance of users, as well as all the nicely written graphical administration tools for X that come with it.

—Delocke

Keith Beattie, author of the Debian Linux 12-Step, replies: *RedHat is certainly an excellent Linux distribution and could have easily sufficed as the distribution to use on the bootDisc. Keep in mind, though, that the overall goal of the article was to distribute an operating system that is a viable—did someone say "superior"?—alternative to the ubiquitous WinBlows OSes. This being the highest priority, any Linux distribution, or even FreeBSD, would have been an acceptable candidate. In my opinion, choosing among different Linux distributions is splitting hairs. The Debian organization most closely follows the model of freely available software development and has been one of the greatest sources of software innovation for more than two decades. It gave birth to Linux and deserves all the support it can get. In the end, though, all the free Unicies and their distributions are better served by supporting each other. Little can be gained by arguing which is "the best."*

His Tiger Won't Purr

I just bought a P-II 266MHz with the fan included on it and a Micronics Tigercat P2 motherboard. Is the fan efficient enough to keep a 266 overclocked to 300MHz running smoothly? When running at 266MHz it purrs like a kitten and spits out a 130 bootMark, but when I tried to overclock it to 300MHz, it wouldn't boot (it powers on, the hard drive fires up, but there's no video). What's the deal? Does Micronics have some kind of Fail Safe Detect or something? I'm at my limits. I've overclocked for two years now, but I'm stumped, and there isn't much support for this kind of problem.

—ghent

Hardware editor Andrew Sanchez replies: *Provided that your ATX power supply's fan is pointing toward your CPU and you're using active cooling (that is, a fan and heatsink combo on the CPU), then you're good to go. Actually, we've overclocked P-IIs using the passive cooling method (heatsink only) and have had no problems. With regard to your second query, congratulations, it seems you've stumbled upon Intel's new protection against overclocking! In some CPU runs, Intel decided not to bond one of the multiplier pins during the manufacturing process, thus robbing you of any overclocking potential—at least, when you try to go up one bin via the 66MHz system bus speed. You can bypass this little protection by upclocking to either a 75MHz or 83MHz system bus. But, according to the manual, it looks like the Tigercat motherboard only supports a 60MHz or 66MHz bus speed. Unless you want to go down to a 60MHz bus speed and go with a 60x5 setting, you're out of luck.*

My Hard Stuff Is Too Slow

Using the Adaptec Threadmark from your bootDisc, I got 1.25MB/sec and 11.31% CPU utilization. Compared to the systems you review, this seems pretty lousy. How do I get faster performance? I have an onboard Ultra Wide Adaptec SCSI system and a SCSI Quantum Fireball hard drive. According to your product reviews, this should be speedy. What can I do? It makes me sick to see my roommate with a normal EIDE hard drive get 3.5MB/sec (with 50% CPU utilization, however).

—Christian Guirreri

Technical editor Sean Cleveland replies: *That is indeed a very lousy score. The CPU utilization is in the right range, but the throughput should be at the least three times your score. The Threadmark test is a benchmark that thrashes the hard drive, doing small reads all over the drive to deliver "real world" performance scores. A test such as the Physical Read test in the bootMark suite (it's on the bootDisc) will give you a balls-to-the-wall pure speed indication of the drive. If the Fireball is a Wide/Ultra Wide drive, make sure it's using a 16-bit pathway (40MB bus instead of 20MB). Also, make sure Disconnect is enabled. Use the shortest possible SCSI cable you can and make sure your termination is properly set. Also ensure the Win95 file system is working properly (go under the Performance tab in System Properties). It should be 32-bit and not using MS-DOS–compatibility mode. If it is, you have a driver problem. Check this under the Device Manager tab. If you see an exclamation point next to the SCSI controllers device, your drivers are screwy.*

> *In some CPU runs, Intel decided not to bond one of the multiplier pins during the manufacturing process, thus robbing you of any* ***overclocking potential.***

Cracking The ProLogic Puzzle

Is it possible for me to connect my current computer to a ProLogic receiver. I know that somehow Gateway does it. Do I need something special, or do I just connect it directly to the soundcard (I have a Soundscape)?

—Michael Narayan

Hardware editor Andrew Sanchez replies: *You don't need any special soundcard. As long as the signals generated by your computer are indeed some type of Dolby Surround Sound (either plain old Surround or discrete, center-channeled ProLogic), the receiver will take those signals and decode appropriately. The best way to check for proper decoding is to try any number of Surround Sound–encoded games, such as recent NovaLogic flight sims and* Wing Commander III, IV, *and* Prophecy. *You can even use the Interplay sound test for games such as* Redneck Rampage. *I'm a strong advocate of this type of sound system scenario and use a similar configuration for my own home computer system. Go for it!*

Faster 3Dfx Frame Rates

I can't figure out why I'm getting bad Voodoo frame rates. Here's my system: Asus P2L97, P-II 300MHz, 64MB 10ns SDRAM, Sierra Screamin' 3D, Orchid Righteous 3D, SoundBlaster AWE32, Win95 rev 2.

I have all the latest and greatest drivers for the Sierra, Orchid, and SoundBlaster. I have DirectX 5.0 installed. I have the latest Glide runtime installed. But the problem is that anything using the Orchid performs like a Pentium 200: FastVid *Quake*, 28.3fps; MDK Perf test, 111; *GLQuake*, 28.5fps.

What the hell am I missing? I'm running my timedemo in 640x480 with no particular tweaks. It seems I should be getting much better rates in *GLQuake*. Many other people on the 3Dfx newsgroups are experiencing the same low frame rates with Pentium II–based systems. I know you fine lads at *boot* are very busy, but do you have any ideas, oh wise and benevolent ones?

—Gregory Domeier

Technical editor Sean Cleveland replies: *I have the same setup as you except I'm using the Number Nine Revolution 3D paired with Diamond's Monster 3D. I get the following scores: MDK Perftest (Win90), 122; GLQuake (Timedemo Demo1), 41.4fps; GLQuake (Timedemo bootMark): 46.7fps.*

I run with optimized settings. Adding the following environment settings for your 3Dfx card can give you a frame rate increase of up to 10fps. Put these settings into your Autoexec.bat file.

```
SET FX_GLIDE_SWAPINTERVAL=0
SET FX_GLIDE_NO_SPLASH=1
SET SST_FASTMEM=1
SET SST_FASTPCIRD=1
SET SST_GAMMA=2.0
SET SST_SWAP_EN_WAIT_ON_VSYNC=0
SET SST_SCREENREFRESH=60
SET SST_GRXCLK=54
SET SST_VIDEO_24BPP=1
```

The SST_GRXCLK line overclocks your 3Dfx card. Look to this month's 12-Step on page 60 for the whole story.

Two Versions Of MMX?

I currently own a Pentium II 266MHz. I recently got ahold of the Multimedia CD-ROM provided by Intel in its retail box version of Pentium MMX chips. When I tried to use the so-called "MMX-compatible" disc on my P-II, the damn thing accused me of not having an MMX machine! What the heck is going on here? Is there different MMX coding for the Pentium and Pentium II?

—Kenny Lim

Hardware editor Andrew Sanchez replies: *As far as we know, there is no difference between Pentium II MMX and plain old Pentium MMX. The disc may by using an older CPU identification in which it looks for the "Intel Genuine Pentium" ID on your CPU. Some games, such as Sega's* Virtual On, *refuse to run on AMD K6 processors, despite the fact they are MMX-compliant parts. It all comes down to CPU identification code. Considering it's an Intel disc, it's somewhat ironic, don't ya think?*

Where's My Weakest Link?

I just went through your 12-Step on benchmarking 3D accelerators (*boot* 17). My 2MB ATI Expression+ and Matrox m3D did OK, but I want more! What can I do to directly increase frame rates? I thought upgrading my Expression+ to 4MB would help, but a friend says that it will only increase colors and resolutions. What does directly affect frame rates? CPU speed? System memory? L2 cache size? Drivers? How can I tweak these to the max?

—Scott Wilkins

Hardware editor Andrew Sanchez replies: *Frame rates, in general, are affected by the things you listed. Most important is the 3D accelerator itself. The m3D (based on NEC's PowerVR) does a decent job with Direct3D games, as does the ATI chipset sitting inside your Expression+. In terms of increasing performance with the 3D hardware you already have, I'd say the most profound factors are CPU speed, system-bus speed, and drivers—followed by everything else, including system RAM and cache (both L1 and L2). Unless you're willing to get a faster 3D accelerator, the only way you'll be able to tweak your performance for faster frame rates is to indulge in a bit of CPU overclocking—bump your current CPU speed up and see if your system can hang. You'll need major cooling for this, and you may frizzle-fry your CPU, so watch it! You can also download the latest drivers from the respective video card manufacturers and fiddle with PCI latency settings in your system BIOS. Finally, you can always drop down to smaller resolutions.*

> "I hope you've got the answers because I'm not paying those **goose-stepping jackals** at MS a stinking red penny for advice."

IRQs—Automatic Or Manual?

If you were putting a machine together for the first time, how would you place the PCI cards—automatic or manual, or what particular IRQ? Lately I've been putting all the IRQs at Legacy except IRQ9, and that has been working fine for me. Is there a better scheme?

—Randy Zimmer

Hardware editor Andrew Sanchez replies: *If you have old DOS-legacy parts that don't show up as Plug-and-Play devices, then it's best to set your PCI configuration in your system BIOS to manual, put that one IRQ on Legacy, and keep it out of the way. Plug-and-Play has long been known as "Plug-and-Pray"—for good reason. So unless all your devices are Plug-and-Play" you're better off with your current scheme for PCI PnP BIOS tweaking.*

Another Dream Deferred

I recently built my dream machine: P-II 266MHz, Asus P2L97, 64MB SDRAM, Diamond Viper V330 AGP, LS-120 a:drive, SB AWE64. I want to overclock it to 300MHz. Do I just change the multiplier on the motherboard to 4.5? I tried this and my machine didn't power up right—nothing showed up on my monitor, although I could hear the system powering up. Also, when I try to turn off my computer, the power button either resets my computer or puts it in sleep mode. I read that newer chips from Intel are not able to be overclocked, but I bought mine a while back. Do you have any suggestions?

—B. Encina

Hardware editor Andrew Sanchez replies: *For bumping your CPU up one bin, yes, a multiplier of 4.5 is the correct setting (66MHz x 4.5 = 297MHz). You may be encountering the much maligned "non-pin-bonding" Intel instigated in its CPUs to combat overclocking. You may want to try playing with the system-bus speeds—try going 75MHz x 4 (300MHz) or 83MHz x 3.5 (290MHz). If you have the P2L97 with the soft jumpers via BIOS, adjust the settings there. If they are motherboard jumper-bound, just set your jumpers to the proper settings and go!*

I Want To Feel Clean Again

Regarding the *boot* 16 12-Step on Stripping and Refinishing Win95: Can I do it with just the upgrade version? I've already removed Win3.11 and don't have the discs to re-install it.

—rayranl

Technical editor Sean Cleveland replies: *No, you can't do it with the upgrade version of Windows 95. The problem is that it requires Windows 3.11 or Windows 95 to be installed before it will even run.*

When A Virus Isn't A Virus

When I used FDISK on my hard drive, it reported "Bootsector Write!!! Possible Virus". I've never seen this before. Can you help me?

—Vinh To

Technical editor Sean Cleveland replies: *You have the Virus Warning option enabled in your BIOS. You want to disable it until you're done FDISKing the hard drive. You can get into your BIOS by hitting F1 or the DEL key when booting your machine (you are usually prompted to do either). That particular option is usually located in the Settings section. The Virus Warning option detects when a write is occurring in the Master Boot Sector (that is, your hard drive). Sometimes it means a virus is invading, but the warning can also spring up when FDISK is running its course.*

And Once Again, We Must Blame The Drivers

I have a P-II 233MHz on an Asus P2LN7 motherboard, a Diamond Viper V330 AGP card, and a Quantum Fireball hard drive. Not the Dream Machine, but it puts a lusty twinkle in my eye. The problem is I'm running Win95 OSR2 and the frigging thing is buggy. The people at Asus say I'm getting a "memory conflict with AGP controller" error when I install an AGP VGA card under Win95 OSR2.

Here's their long answer: "This problem is caused by a buggy driver provided by Microsoft in Win95 OSR2. Under Windows 95 (OSR2 versions), there is a VgartD.VxD virtual device driver which is handling the traffic between local VGA RAM and system memory through the AGP bus, and it's producing some 'side effects.' Microsoft has removed the bug in the driver in the beta version of Win98. Please make a proper adjustment to your system."

Excuse me, but "adjust your system" does not constitute an answer. To the best of my knowledge Microsoft is not handing out free versions of its latest bug-ridden bloatware. And a search of their sewer—er, I mean site—revealed no patch. I may be wrong, but I'm assuming the card and system are not working at peak with this conflict still going on. I hope you've got the answers because I'm not paying those goose-stepping jackals at MS a stinking red penny for advice. Despite your valid criticism of the Viper V330, it's still a wicked card. Too bad I can't use it to its fullest.

—Steimer Greer

Technical editor Sean Cleveland replies: *I'm using the same CPU, motherboard, and hard drive, and only noticed problems with the ATI Xpert@Play and Photoshop 4.0. The system works stellar in every other way. I don't think your problem is with OSR2. The VgartD.VxD file you refer to is supplied by the video-card manufacturer and not Microsoft. Your problem may be cleared up by a simple driver update from Diamond. Using OSR2 build 1212, we tested that motherboard thoroughly with the following chipsets: nVidia Riva 128 AGP, Rendition V2200 AGP, and ATI Rage Pro AGP. (The motherboard was featured in boot 15 and got a bootVerdict of 9 as well as a Kick Ass award.) We did not test the Viper V330 AGP on the Asus P2L97 as we did not have one handy at the time of the review. If we do have problems, though, we'll let you know. For now, try updating your drivers. Also make sure that you're running build 1212 of OSR2. If not, run the USB supplement found on this month's bootDisc in the Workbench section.* ▮

VOODOO^2

The biggest, baddest, ugliest toy on the block.

And you can be the first one on your block to get one. Find the five Voodoo^2 ads from 3Dfx Interactive within this issue (only) and identify the game each character represents. Write the game titles in any order in the appropriate space on the attached business reply card and mail in to enter.*

Win

5 FIRST PRIZES: A 3D graphic accelerator board featuring the incredible new Voodoo^2 chipset – the Demon Speed has found a home. This board will play the 3Dfx-compatible games you currently own faster and smoother than you thought possible.

4 SECOND PRIZES: Four complete Voodoo^2-optimized games from four of the top game publishers – Electronic Arts, Activision, Interplay and Eidos. These titles take advantage of Voodoo^2's phenomenal speed and breathtaking visuals. Whether you run these titles on Voodoo^2 or first-generation Voodoo, the gaming experience is unmatchable.

100 THIRD PRIZES: A Voodoo T-shirt direct from 3Dfx. The exclusive 3Dfx Interactive T-shirt for the Voodoo family of 3D graphic accelerator chips.

3Dfx Interactive

www.3dfx.com

DIAMOND MULTIMEDIA

Ask your retailer for a 3D graphic accelerator featuring 3Dfx's Voodoo^2 chipset – the new turbo-speed accelerator in 3Dfx's Voodoo family. You can find the Voodoo^2 chipset on Diamond Multimedia's Monster 3D 2 and Creative Labs Blaster 3D Voodoo^2. Or visit our website at www.3Dfx.com for more information.

CREATIVE

*Follow the directions below to send without the pre-printed business reply card.

Sweepstakes Rules:

1. No Purchase Necessary: To enter, mail a standard size postcard containing name, address, and phone number to Voodoo^2 Sweepstakes, 3Dfx Interactive, Box V2boot, 4435 Fortran Drive, San Jose, CA 95134. No purchase or payment of any money is necessary to enter. One entry per household. All entries must be handwritten. Mechanically reproduced entries will not be accepted. Entries must be received by April 30, 1998. All entries become exclusive property of Sponsor and will not be acknowledged or returned. Sponsor assumes no responsibility for lost, mutilated, late, illegible, incomplete, postage-due, or misdirected entries. Only one prize per family, organization, or household. Please allow 6-8 weeks delivery.
2. Prizes: 5 First Prizes. First Prize winners receive one (1) 3D graphic accelerator board featuring Voodoo^2 chipset. First Prize has an approximate retail value of $300.00. 4 Second Prizes: Second Prize winners will receive four (4) different PC software titles published by Electronic Arts, Activision, Interplay and/or Eidos all optimized for Voodoo^2 gameplay. Second Prize has an approximate retail value of $240.00. 100 Third Prizes: Third Prize winners will receive one (1) 3Dfx Voodoo T-shirt. Third Prize has an approximate retail value of $20. Winners will be determined by a random drawing from all valid entries received by 3Dfx Interactive whose decisions are final. Drawing to be held on or about May 15, 1998. All prizes will be awarded. All prize winners will be notified by mail. Prize(s) are non-transferable. No substitutions of prize(s) are allowed, except at the option of Sponsor should the featured prize(s) become unavailable.
3. Odds of Winning: The odds of winning will be determined by number of valid entries received.
4. Eligibility: Contest open to residents of United States and Canada. Void in Rhode Island and Quebec. Non-compliance with the time parameters contained herein or return of any prize/prize notification as undeliverable will result in disqualification and an alternate winner will be selected. Winners or their legal guardians shall sign an affidavit of eligibility/release of liability/prize acceptance within 30 days of receipt or forfeit prize. By acceptance of prize, winner(s) agree to the use of their name and/or likeness for purposes of advertising, trade, or promotion without further compensation, unless prohibited by law. Employees of 3Dfx Interactive, Diamond Multimedia, Creative Labs, Electronic Arts, Activision, Interplay, Eidos, Imagine Publishing and their respective affiliates are not eligible. Neither 3Dfx Interactive, Imagine Publishing nor their respective affiliates, subsidiaries, divisions, or related companies are responsible for any damages, taxes, or expenses that consumers might incur as a result of this contest or receipt of prize. Winners accepting prizes agree that all prizes are awarded on the condition that 3Dfx Interactive, Imagine Publishing and their agents, representatives, and employees will have no liability whatsoever for any injuries, losses, or damages of any kind resulting from acceptance, possession, or use of the prizes.
5. Winners List: For a list of winners, send a stamped, self-addressed envelope to "Voodoo2 Sweepstakes Winners List", 3Dfx Interactive, Box V2boot, 4435 Fortran Drive, San Jose, CA 95134. Requests for winners lists must be received by May 30, 1998. Allow 4 weeks for delivery of winners list.
6. Restrictions: Void where prohibited or restricted by law. All federal, state and local regulations apply.
7. Sponsors: This sweepstakes is sponsored solely by 3Dfx Interactive, Inc.

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EACH MONTH, **BOOT** EDITORS GATHER THE **BEST** PRODUCTS IN A SPECIFIC **CATEGORY** AND DEEM THEM: **BOOTWORTHY**

SOUN

Aural Pleasures

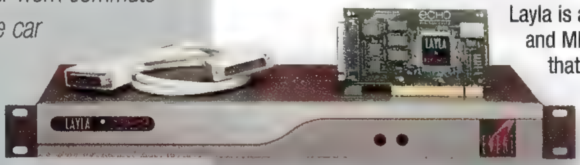
Of the five senses, hearing may be the one most taken for granted. We read e-mail, play games, compute spreadsheets, and type reports, but we rarely realize just how important hearing is to our daily activities. Would Quake be as fun if it were silent? Would your work commute be tolerable without the car stereo? We think not.

Whether you are an accountant or a musician, audio plays a big role in our digital lives, and the better the quality, the more enjoyment you'll get from it. We're gonna open your ears to some of the sweetest-sounding boards your hard-earned green can buy—spanning six different categories from pro-audio production to game-enhancing 3D sound. We bet there's an audio solution here for your budget and your PC.

—Daevid Vincent

Best Multi I/O Card

Event Electronics Layla



Layla is another cross-platform PnP (using only one IRQ for both audio and MIDI functions and no DMA channels) PCI bus-master host card that connects to an external rack-mount audio interface with eight inputs and ten outputs (balanced 20-bit analog and 24-bit S/PDIF stereo digital I/O). It also has massive onboard DSP (via Motorola's latest generation 56301, a 24-bit chip running at 80MIPS), word clock (for sync and expansion), a 24-bit signal path, and MIDI in/out/thru. The best part of this system is the software, or rather lack of. Layla looks like a collection of five stereo sound cards to your PC, so most any multiport sequencer will work with it. EasyTrim automatic-gain-adjustment circuitry automatically sets the input gain for maximum possible dynamic range. Multiple Layla's can be used in conjunction in the same system.

product info

Price $999
Company Event Electronics
Phone 805.566.7777
URL www.event1.com

Best 3D Audio Card

Diamond Monster Sound

Four-speaker surround sound and PnP PCI is the defining attribute of this sonic solution. The Analog Devices DSP takes on the processing task of up to 24 independent 44KHz audio streams, freeing up the CPU to do other things. Unfortunately, there's no DOS support, but then again, who really needs it? The APIs of choice are Microsoft's DirectSound 3D and Aureal's A3D, so there should be no compatibility issues. Onboard are 32 voices of hardware wavetable, but for best results, we suggest you plug this monster alongside a trusted legacy board such as an AWE32 or AWE64. Monster Sound also provides an accelerated gameport under Windows 95 for improved joystick performance.

product info

Price $149
Company Diamond Multimedia
Phone 408.325.7000
URL www.diamondmm.com

FOUR INDEPENDENT OUTPUTS PRODUCE STUNNINGLY IMMERSIVE SURROUND-SOUND EFFECTS.

DCARDS

Best Gaming Card

Maxi Sound Game Theatre 64

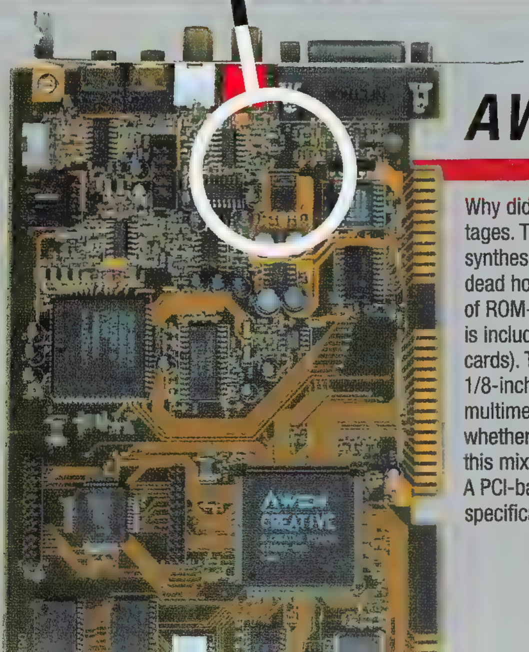
An all-around excellent choice for gamers and musicians alike, the ISA-based Game Theatre 64 is essentially a scaled-down Home Studio Pro. It has the same 64-voice wavetable sound engine and 50MIPS Dream RISC DSP chip. An onboard 72-pin SIMM slot can bump the sample RAM to a total of 20MB, and a WaveBlaster header connector allows for even more expansion. Most impressive is the addition of DirectX 5 and DirectSound 3D-compatible surround sound. The Game Theatre even supports Sound Font technology. The only drawback is that it's a resource hog, requiring two IRQs and two DMAs. And for legacy support, DOS is supported, although the card is usually always auto-detected as an SBPro rather than an SB16/AWE32.

product info

Price $199
Company Ubi Soft Entertainment
Phone 800.824.7638
URL www.ubisoft.com

QUAD OUTPUT TURNS ANY GAME INTO AN EXPERIENCE.

DIGITAL OUT SOUNDS FABU, BUT WHAT CONSUMER/GAMER IS GOING TO HAVE AN S/PDIF D/A CONVERTER?



AWE64 Gold

Why didn't we include the AWE64 Gold? Its price is steeper than the Game Theatre 64, with few advantages. The excellent EMU8000 wavetable synthesizer, along with the mixer, DAC, and Vibra 16 chip (FM synthesizer) integrated into one core-logic chipset, are great additions, but Creative Labs is beating a dead horse. ISA and SoundBlaster legacy compatibility are tired technologies. This card offers only 1MB of ROM-based 32-voice wavetable and another 32 voices in SoundFont software (4MB of onboard RAM is included, expandable to 28MB via proprietary daughtercards). The male 1/8-inch jack on the supplied male RCA-to-1/8-inch Y-cable should also have female to better facilitate multimedia speakers. Creative Labs apparently couldn't decide whether it wanted its card to be pro- or consumer-oriented; this mixture of features gives the card a split personality.

A PCI-based AWE64D, utilizing the EMU8008 chip and designed specifically for the OEM market, is slated for Q1/98.

product info

Price $250
Company Creative Labs
Phone 800.998.5227
URL www.creativelabs.com

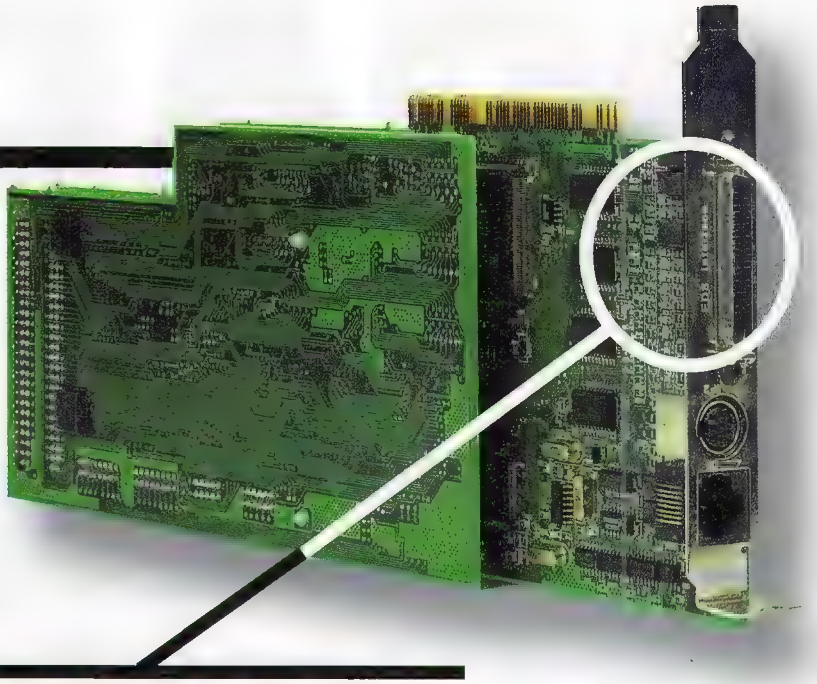
Best Professional Audio Solution

Ensoniq Paris

Paris is the only card of the bunch that has a tactile control surface. This PnP PCI card has six custom ESP-2 VLSI chips that scream at 26MIPS each to process up to sixteen 24-bit, 48KHz real-time effects, depending on the algorithm. A maximum of 128 simultaneous tracks are selectable from a pool of 999 virtual tracks, all streaming out of two 8-channel output cards within and up to 20 physical ports when combined with a Modular Expansion Chassis (MEC). Paris comes with its own cross-platform digital-audio software with hooks to sync any additional MIDI sequencer desired, such as Cakewalk or Cubase. A variety of analog and digital I/O options are currently available and more are in development for almost any configuration desired.

product info

Price $3,400 as reviewed
Company Ensoniq
Phone 610.647.3930
URL www.paris.ensoniq.com



MEAN AND LEAN, ALL CONNECTIONS ARE MADE VIA AN EXTERNAL BREAKOUT BOX.

Digital Audio Labs V8

A runner-up professional audio solution would have to be the V8. Although it's more expensive than the Paris and is currently ISA-based, its many benefits overcome the price tag.

Famous for the CardD+, DAL's multicard ISA solution is capable of 16 physical I/O tracks (32 with the PCI version slated for Q3/98) and incorporates up to eight 300MIPS Motorola 56002 Supercharger DSP chips for real-time effects processing and mixing. In fact, the CardD+ can be linked in for an additional two ins/outs.

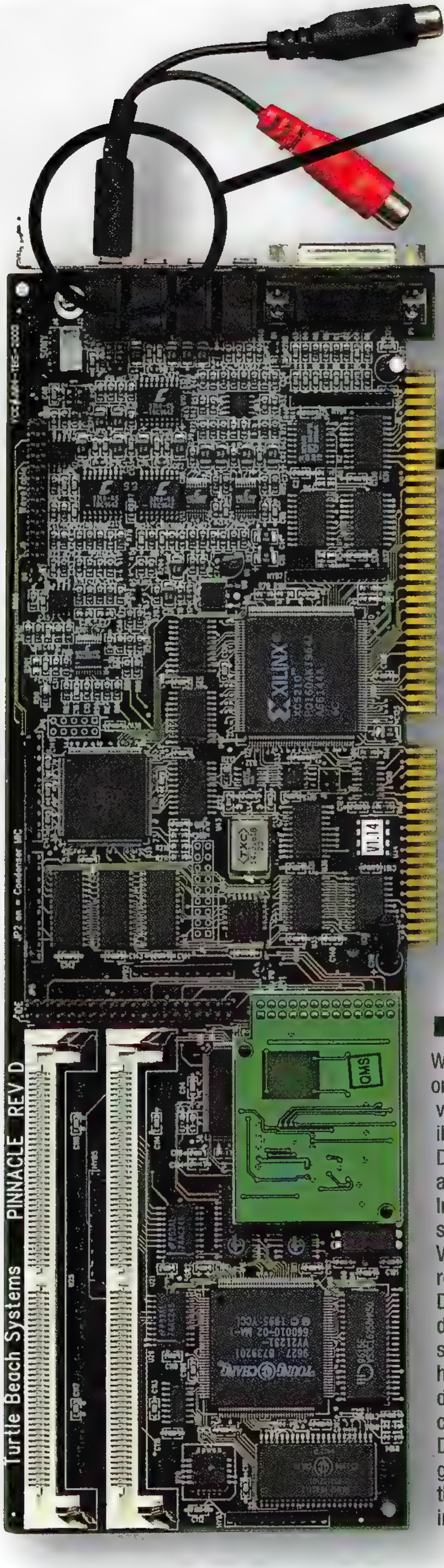
Several vendors, such as SEK'D (*Samplitude Studio*), Minnetonka Software (*MxTrax*) and *Cakewalk*, have special native-V8 versions of their software that take full advantage of the V8's hardware capabilities. Conversely, other software sees the system as up to four stereo-wave devices, and third-party developers are creating V8 plug-ins such as Waves, Q-Sound, LR Sound, and Antares.

product info

Price $4,580, average system
Company Digital Audio Labs
Phone 612.559.9098
URL www.digitalaudio.com/v8

Digital AUDIO
V8

DON'T BE MISLEAD, NOT ALL OF THESE CARDS ARE REQUIRED FOR AN AVERAGE SYSTEM



THE PINNACLE'S MIKE INPUT DOES DOUBLE DUTY AS THE S/PDIF I/O PORT VIA A 1/8-INCH-TO-RCA Y-CABLE.

Best Home Studio Card

Turtle Beach Pinnacle/ Project Studio

Turtle Beach provides the perfect all-around ISA solution for the home musician who demands professional quality at an affordable price. This board is ultra-quiet (with an S/N of <-97dB), can be expanded to 48MB of onboard sample RAM using two 72-pin SIMM slots, incorporates the Kurzweil MA-1 MASS Synth Engine with VAST Architecture, and has S/PDIF digital I/O. For those who love to tweak sounds, an included editor librarian allows for severe manipulation of the timbres with full non-zippered MIDI control. Built-in reverb and chorus can be individually assigned on each channel. The WaveBlaster header is occupied by another 32-voice Kurzweil MA-1 chip daughtercard. Included in the bundle is Voyetra's Digital Orchestrator Plus and Wave SE-II, so you can be off and creating in no time.

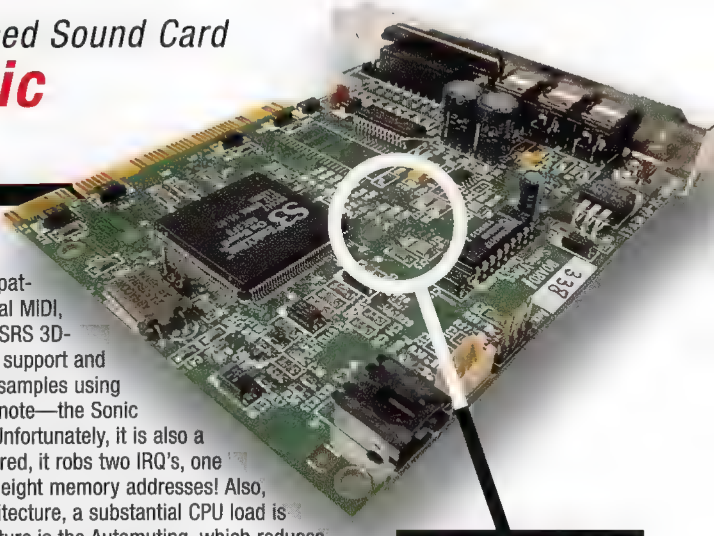
product info

Price $500 (with digital I/O)
Company Turtle Beach
Phone 800.233.9377
URL www.tbeach.com

Best PCI-Based Sound Card

S3 Sonic Vibes

With up to 4MB of onboard ROM for 32 voices, SB Pro legacy compatibility, FM synthesis, general MIDI, DirectSound, DirectMusic, SRS 3D-audio enhancements, DOS support and InfiniPatch (downloadable samples using system RAM)—all for a C-note—the Sonic Vibes is the clear winner. Unfortunately, it is also a resource hog; fully configured, it robs two IRQ's, one DMA, and an unbelievable eight memory addresses! Also, despite its PCI-based architecture, a substantial CPU load is still required. One nice feature is the Automuting, which reduces hissing during periods of digital silence, a built-in chorus and reverb effects DSP enhance the output to give even more depth to this already sweet-sounding board.



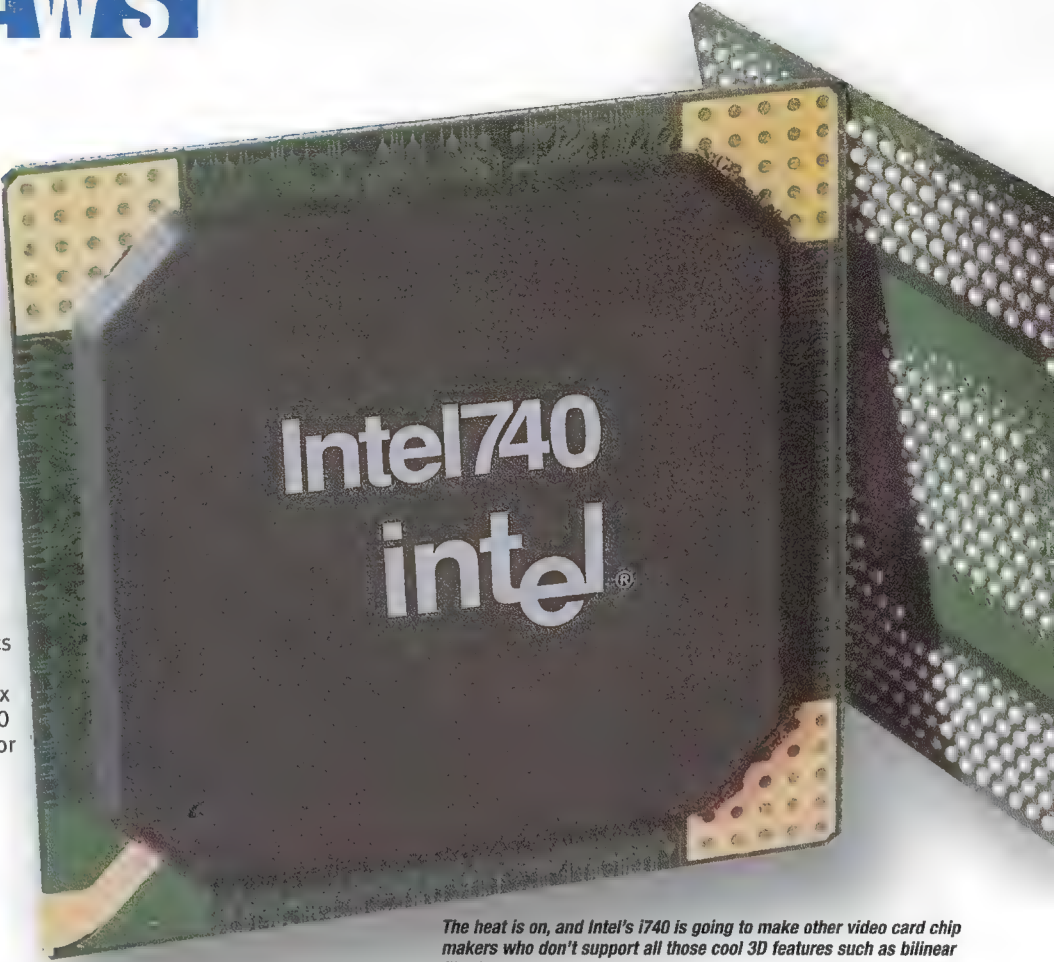
A SIMPLE AND COST-EFFECTIVE WAY TO ADD SOUND TO ANY SYSTEM.

product info

Price $100
Company S3
Phone 408.588.8000
URL www.s3.com/products

Intel **i740**

Guess who's coming to 3D?



The heat is on, and Intel's i740 is going to make other video card chip makers who don't support all those cool 3D features such as bilinear filtering and the such think twice.

They laughed when Intel got into the core-logic chipset business. But whose PCIset appears in almost every modern motherboard today? So, the same naysayers who question Intel's jump into the video card industry with its i740 (a.k.a. Auburn) had better step back and take a look at Intel's past accomplishments and tremble appropriately.

Lets start off with i740's logistics and statistics. Designed from the ground up as a full-featured AGP 2x part with sideband addressing, i740 is a complete 64-bit video processor aimed at the likes of ATI, nVidia, and Matrox. This 2D/3D accelerator is the product of three vendors' engineering expertise. Chips and Technology, recently acquired by Intel and better known for helping light up notebook LCD panels, helped out on the 2D side. Also integrated into i740 is a dedicated video engine pipeline for DVD/software MPEG-2 support, and flash BIOS guarantees i740's BIOS will never go out of style. The architecture is flexible, with vendors having the option to add hardware DVD (via a card's VMI port), TV-in/out, and more.

i740's 64-bit split memory architecture uses 100MHz SDRAM or SGRAM for frame-buffer and texture storage (up to 800MB/sec bandwidth for this tiled local memory system), with maximum RAM specifications changing depending on which system bus is employed. Although Intel will tell you that i740 is AGP only (where it'll use up to 8MB of memory), some vendors are designing PCI parts that can take advantage of up to 16MB of texture memory. The integrated 205MHz RAMDAC can get you resolutions up to 1600x1200, depending on memory configurations.

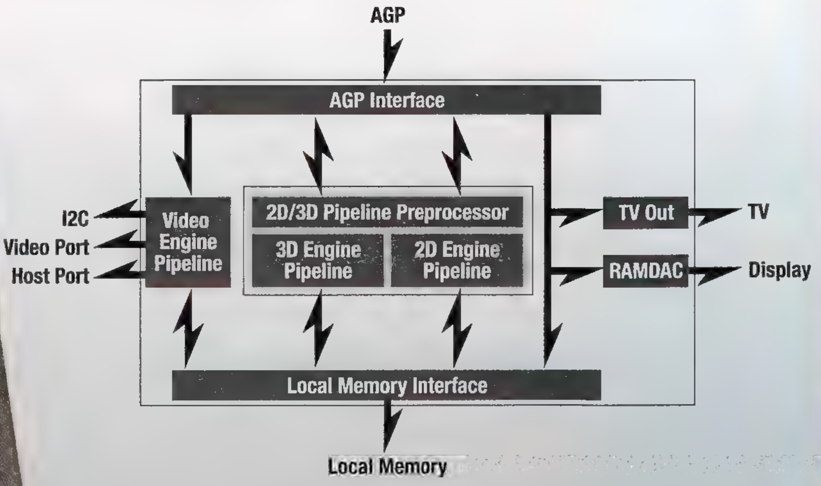
Real3D's Starfighter is among the many i740-based video cards vying for your attention. Intel plans a massive motherboard invasion as well.

When it came time to spec out i740's 3D texel-pushing capabilities, Lockheed Martin's Real3D division was chosen. Why? Take a look at Sega's jaw-dropping *Virtua Fighter 3* to glimpse the raw polygon-pushing power Lockheed Martin's 3D technology developed. At 640x480, it runs at a solid 60fps.

A 32-bit floating-point accurate set-up engine takes care of set-up and rendering duties, leaving the host CPU to perform geometric calculations. i740's 3D rasterizer allows parallel processing of polygons (up to four fully textured, shaded, fogged, and Z-buffered pixels per clock). By formatting this data in parallel, i740 claims to maintain polygon vertex and texture calculations with subpixel accuracy, resulting in less texture jumping or "shimmering" and polygon popping. Intel claims interpolation will happen on every pixel with up to 32 bits of accuracy (a process it calls Precise Pixel Interpolation).

Your favorite 3D visual enhancements are supported, including flat/gouraud shading, bilinear filtered mip-mapping, stippled transparency, per-pixel perspective correction, color alpha-blending, fogging, anti-aliasing, and more. Ranging in size from 1x1 texel to 1024x1024, up to 11 levels of detail (multiple copies of the same texture map in different resolutions) are supported, and i740 can store non-square textures on the integrated cache located in the processor. And since i740 is an AGP part, it

Inside Intel's i740



The Intel i740 consists of dedicated multimedia engines executing in parallel to deliver high-performance 3D, 2D, and video capabilities.

Engineered to match the performance of its own Pentium II processor, i740's use of Direct Memory Execution (DME) allows boards to come with as little as 2MB and still promise performance comparable to larger memory-armed boards.

i740 is optimized for a batch-process mode of triangle delivery, which allows the CPU to place a "batch" of triangles in memory and begin on another batch of triangles without needing to perform handshaking with the 3D processor.

While Intel's official party line is that i740 is a strict AGP 2x/sideband part, companies such as Real 3D (the designer of the part) will come out with a PCI version of the board.

can store textures in system memory and execute them straight from system RAM to the 3D processor, bypassing local memory and the possibility of texture thrashing.

i740 will support DirectX, Direct3D, and OpenGL (both MCD and ICD). OSes under i740's usage domain include Win95 OSR2.1, Win98, and NT 4.0 and 5.0. Under a P-II 300 AGP system and a 2MB i740 reference board, *Quake II* coughed a cool 40fps under the timerefresh benchmark. Unfortunately, the version Intel had didn't have timedemo enabled, so no scores were taken from that benchmark. *Jedi Knight* was able to run at 1280x1024 at an average of 10fps to 16fps, but dropping the resolution down to 640x480 boosted speeds to an average of 60fps.

Even with a bare-minimum configuration of 2MB, the i740 is capable of up to 20Kpolys/frame, and the sheer variety of configurations will make OEMs jump for joy. Intel has already landed deals with ASUStek, Diamond Multimedia, Leadtek, Number Nine, STB, Real3D, and others to produce i740 video cards. Expect motherboards to carry i740 onboard as well, although none have been formally announced. While the majority of OEMs will cater to the AGP crowd, Real3D's Starfighter board will be available in either AGP or PCI.

All this power comes with a price—current i740 preproduction/reference boards run hot compared to other video processors and often sport massive heatsinks or fans. If Intel cannot conquer the heating problems, OEMs may be forced to add cooling solutions, driving up the cost of the final product.

Once i740 rears its head, mainstream 3D may never be the same. Intel's promising Voodoo performance in a cost-effective all-in-one package has fast 2D as well. Intel's mighty fabs and intense marketing muscle will help i740 meet its expectations, so everyone else had best pick up their 3D pace—or get out of the way.

—*Andrew Sanchez*

product info

Available Q1 1998
Price $199 and up (depending on configuration)
Company Intel
Phone 800.548.4725
URL www.intel.com, www.real3d.com

HARDWARE ON THE HORIZON AND **SOFTWARE** SOON TO SHIP

The boot Tracking Sheet

TITLE	DEVELOPER	DATE
Monster 3D 2	**Diamond Multimedia**	**Mar-98**
Renegade 3D	**Jazz Multimedia**	**Mar-98**
3D Blaster Voodoo 2	**Creative Labs**	**Mar-98**
Intel Pentium II 333MHz/Slot 1	**Intel**	**Mar-98**
Baldur's Gate	Bioware/Interplay	Mar-98
Unreal	Digital Extreme/ GT Interactive	Mar-98
Powerboat Racing	VR Sports	Mar-98
SIN	Ritual/Activision	Mar-98
Dark Vengeance	Reality Bytes	Mar-98
Daikatana	Ion Storm/Eidos	Mar-98
Interstate 76 Nitro Pack	Activision	Mar-98
[illegible]	Digital [illegible]	Mar-98
Outwars	Microsoft	Mar-98
AMD K6 300MHz	**AMD**	**Apr-98**
Half-Life	Sierra Online	Apr-98
Battlezone	Activision	Apr-98
Falcon 4.0	Microprose	Apr-98
Red Line Racer	Criterion/Ubi Soft	Apr-98
Trespasser	DreamWorks	Apr-98
Baseball 3D	Microsoft	Apr-98
The Dark Project	Looking Glass Technologies	Apr-98
Anarchy	Microsoft	Apr-98
F-22 Total Air War	DID/Ocean Inc.	Apr-98
Ultimate Race Pro	Kalisto/Microprose	Apr-98
Redline	Beyond Games/Accolade	Apr-98
Intel 440BX AGPset	**Intel**	**02/98**
K6 3D	**AMD**	**02/98**
SiS 5591 Socket 7 AGPset	**SiS**	**02/98**
Requiem	3DO/Cyclone Studios	02/98
Extreme Warfare	Trilobyte/Red Orb	02/98
Grand Prix Legends	Papyrus/Sierra Online	02/98
Reno Air Racing	Papyrus/Sierra Online	02/98
MechCommander	Microprose	02/98
The Dark Project	Eidos/Looking Glass	02/98
Riot	Microsoft	02/98
Grim Fandango	LucasArts	02/98
Dark Vengeance	Reality Bytes	02/98
Descent: Free Space	Interplay/Volition	02/98
Pentium II 0K cache	**Intel**	**03/98**
Kings Quest: Mask of Eternity	Sierra	03/98
10th Planet	Bethesda	03/98
Messiah	Shiny/Interplay	03/98
Windows 98 Memphis	Microsoft	03/98
Duke Nukem Forever	3D Realms	03/98
Star Trek: Klingon Honor Guard	Microprose	03/98
Descent III	Interplay/ Outrage Entertainment	04/98
Prey	3D Realms	04/98
Starship Troopers	Microprose	04/98
Windows NT 5.0	Microsoft	04/98
K6+3D	**AMD**	**04/98**

*These dates are subject to change
**Bold indicates hardware

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chess, backgammon, reversi, checkers, chat, and more!

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people playing → people

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REVIEWS

bootLab **Policy**

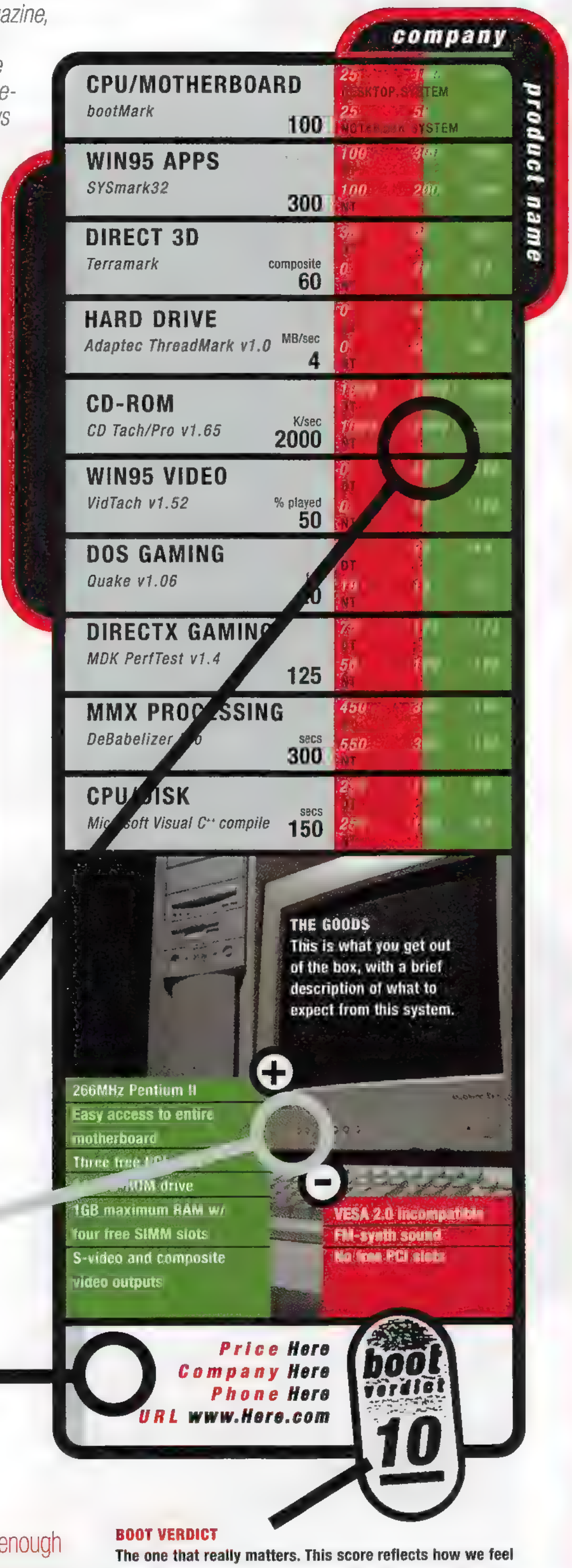
***boot** isn't like any other computer magazine, and neither is our product-**evaluation** process. We don't test equipment in the cold, sterile environment of a warehouse-sized lab, and we don't write our reviews based on the **test scores** that labcoat-wearing technicians scribble on clipboards.*

*Our review **scores** are based on a combination of objective **benchmark** testing, real-world performance, and our subjective evaluation of features, performance, and the many less tangible **characteristics** that go into a product. All our evaluations are based on **hands-on** use of the product.*

3D Benchmarks

Final Reality and X

We've added two new tests to our 3D benchmarking bag of tricks. X is an upcoming Direct3D space-combat and trading game from EgoSoft. The demo runs through a scripted series of scenes and reports an average frame rate. Final Reality, a comprehensive 2D/3D benchmark developed by VNU European Labs, is based around a game engine from Remedy Entertainment's upcoming Max Payne. *It tests several flythrough scenes, as well as some abstract performance tests. Look for both new tests on the bootDisc.*


company
product name
CPU/MOTHERBOARD
bootMark
100
DESKTOP SYSTEM
NOTEBOOK SYSTEM
WIN95 APPS
SYSmark32
300
DIRECT 3D
Terramark
composite
60
HARD DRIVE
Adaptec ThreadMark v1.0
MB/sec
4
CD-ROM
CD Tach/Pro v1.65
K/sec
2000
WIN95 VIDEO
VidTach v1.52
% played
50
DOS GAMING
Quake v1.06
DIRECTX GAMING
MDK PerfTest v1.4
125
MMX PROCESSING
DeBabelizer
secs
300
CPU/DISK
Microsoft Visual C++ compile
secs
150
THE GOODS
This is what you get out of the box, with a brief description of what to expect from this system.
+
266MHz Pentium II
Easy access to entire motherboard
Three free PCI
ROM drive
1GB maximum RAM w/ four free SIMM slots
S-video and composite video outputs
−
VESA 2.0 incompatible
FM-synth sound
No free PCI slots
Price Here
Company Here
Phone Here
URL www.Here.com
boot verdict
10

REAL-WORLD BENCHMARKING

The new meter has the precise scores for each category benchmarked. Plus, the color bars to the right give you a quick idea of how well the system performed in that category.

It's simple: The farther right the bar reaches, the better the system scored. Green means the system performed on par or beyond what we expect of a current system. If you see nothing but red, the system performed below expectations.

PLUSES AND MINUSES

Here's where we list the best and worst a system has to offer.

CONTACTS

Look here for price and the company's phone number and URL if you want more information.

BOOT VERDICT

The one that really matters. This score reflects how we feel about a system, taking into account the benchmark results, quality of parts, usability, overall performance, and our intense, under-the-hood scrutiny.

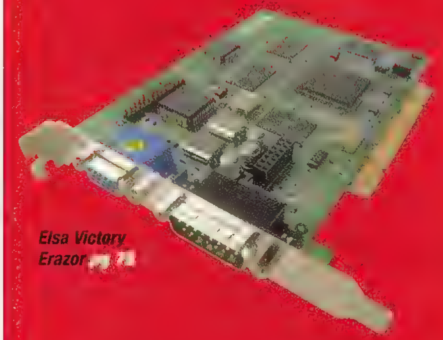
Only the **best** earn enough respect to be worthy of our **editors'-choice** award.

KICKIN' THE TIRES ON
THE LATEST **HARDWARE**
AND TAKIN' THE NEWEST
SOFTWARE OUT FOR A SPIN

ViCam Color Digital Video Camera pg [illegible]

HARDWARE

Falcon Northwest MachV	74
Elsa Victory Erazor	79
Syquest SparQ	82
Platinum Sound SWX-1600	82
Hercules Thriller 3D	84
Jazz Outlaw 3D	84
Micron Millennia XKU 300	86
ViCam Color Digital Video Camera	88



Elsa Victory Erazor pg [illegible]

SOFTWARE

MediaStudio Pro 5.0	76
Quake II	77
Turok Dinosaur Hunter	78
Lego Island	78
Red Baron II	80
Flying Corps Gold	80
Wing Commander Prophecy	83
G-Police	88
Ray Dream 3D	89

Falcon **Northwest** MachV

Cutting-edge conundrums

The made-to-order MachV's a literal who's who of computer components. With a 300MHz Pentium II (nestled nicely on an Asus 440LX motherboard), 128MB SDRAM, a SCSI RAID controller card (with two 4.5GB Ultra Wide Cheetah 10,000RPM hard drives!), DVD-ROM, a Zip drive, and a superlative video subsystem consisting of a Viper V330 and an Obsidian 100SB, the MachV simply screams power!

Regardless of all that testosterone, we're forced to admit that sometimes too much of a good thing can be a bad thing.

Not that the MachV is bad. With performance already besting one of our tough new benchmark standards, the MachV is one hell of a macho beast. Manly yes. But kick-ass? No.

This system, in all its glory, can be had for a mind-numbing $8,000. We're not complaining about the price, mind you—that DTP 2144 SCSI RAID controller card, two hard drives, and 21-inch Viewsonic monitor don't come cheap—but for that level of investment, we'd expect the system to work flawlessly. And it doesn't.

The biggest offender was the hard drive setup. Although the inclusion of a RAID controller card is dubious at best (for a gaming machine), we're pretty sure Falcon Northwest threw it into the mix just to demonstrate their temerity. But when it came time to benchmark, we noticed a couple of strange things. First, performance wasn't up to snuff (see sidebar), and secondly, the software for the RAID setup isn't pre-installed (although the diskettes—to *boot*'s, and Falcon's, surprise—are included). To its credit, Falcon Northwest realizes RAID 0 is not "technically the smartest thing in the world to do." But if you're spending the extra $2,500, you'd probably expect it to be optimized for every type of application you can throw at it (such as video-editing apps) and not just for "typical game accesses," as the company claims. Instead, the drives delivered middling performance.

The second offender was the Lightning 4 digital game card. With two game ports, a digital/analog toggle, and support for up to 8 four-button, four-axis controllers, the specs sure sounded hot. An assortment of included analog-only controllers from CH Products all worked flawlessly, but we ran into problems with other dedicated digital controllers. Thrustmaster's new Millennium 3D joystick and Rage3D gamepad wouldn't work in *either* mode, and we could only use four buttons on Logitech's eight-button digital gamepad. Worse yet, the toggle switch is hardware-mounted on the ISA card, making it a pain to access if you placed your MachV under your desk.

The Altec Lansing ACS500's are impressive, but Altec has other offerings that sound better. And although the SoundBlaster 16 and Yamaha MIDI daughtercard are good, a PCI audio solution (such as S3's SonicVibes or even Diamond's MonsterSound) would be even better.

As expected, the MachV knocked off most of our benchmarks without breaking a sweat. Notable benchmark killers were the Plextor UltraPleX SCSI 32x CD-ROM (with a transfer rate of almost 2,900K/sec) and anything that took advantage of either the nVidia or Obsidian video cards (*Forsaken* was a giddy blur at 126fps!).

The best thing about the MachV is that it's completely customizable. Falcon Northwest will build to your specs. Cool.

—Bryan Del Rizzo

under the hood

THE BRAINS	
CPU	Intel Pentium II 300MHz
L2 Cache	512K internal
RAM	128MB SDRAM (384MB max)
Motherboard	Asus P2L97 with Intel 440LX chipset
THE BRAWN	
Video	Diamond Viper V330 with 4MB SGRAM; Quantum3D Obsidian 100SB 12MB SLI
Hard Drive	Two Seagate Cheetah 4.5GB SCSI UW drives with DPT 2144 PCI to Ultra Wide SCSI RAID Caching Controller with 64MB EDO RAM
CD-ROM	Plextor UltraPleX 32x SCSI CAV with 512K cache
Expansion	Four PCI, two ISA, one PCI/ISA shared, one AGP
Fax/Modem	Diamond SupraExpress 56.6Kbps K56-compatible (external)
I/O Ports	Two serial, one parallel, two USB, digital MIDI/gameport
THE BEAUTY	
Case	Three 5.25-inch bays; two 3.5-inch bays
Display	Viewsonic G810 21-inch; .25mm dot pitch; Invar Shadow Mask; 1600x1200 max resolution; 89KHz max refresh rate
Sound	Creative Labs Vibra 16 with Yamaha Waveforce XG MIDI daughtercard
Speakers	Altec Lansing ACS500 with two 16-watt satellites and one 25-watt subwoofer
Other	Creative Labs DVD-ROM kit, with MPEG decoder board; Iomega 100MB Zip drive
Joystick	CH Products F-16 Fighterstick, Racing Wheel, Throttle, and Pro Pedals

THE BUNDLE None

boot 1:24 down :07

EXPANSION MAP

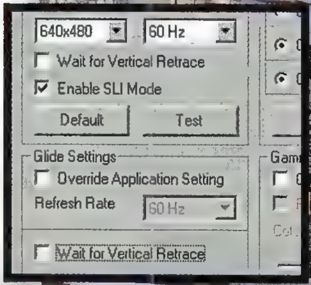
AGP	2D/3D Video
PCI	Free
PCI	MPEG Decoder
PCI	High-End Video
PCI/ISA	SCSI RAID Controller
ISA	Sound Card
ISA	Digital Gameport

CFL EXPANSION TEAMS

You won't find much room inside the case, but it doesn't really matter—the MachV is already chock full of valuable nutrients.

CABLE READY

Thanks to the 2D/3D card, a dedicated 3D card, and an MPEG/DVD decoder card, you'll use a fair number of pass-thru connectors. TV-out ports are dutifully included, as is a terrific control panel courtesy of Quantum 3D's Obsidian card.



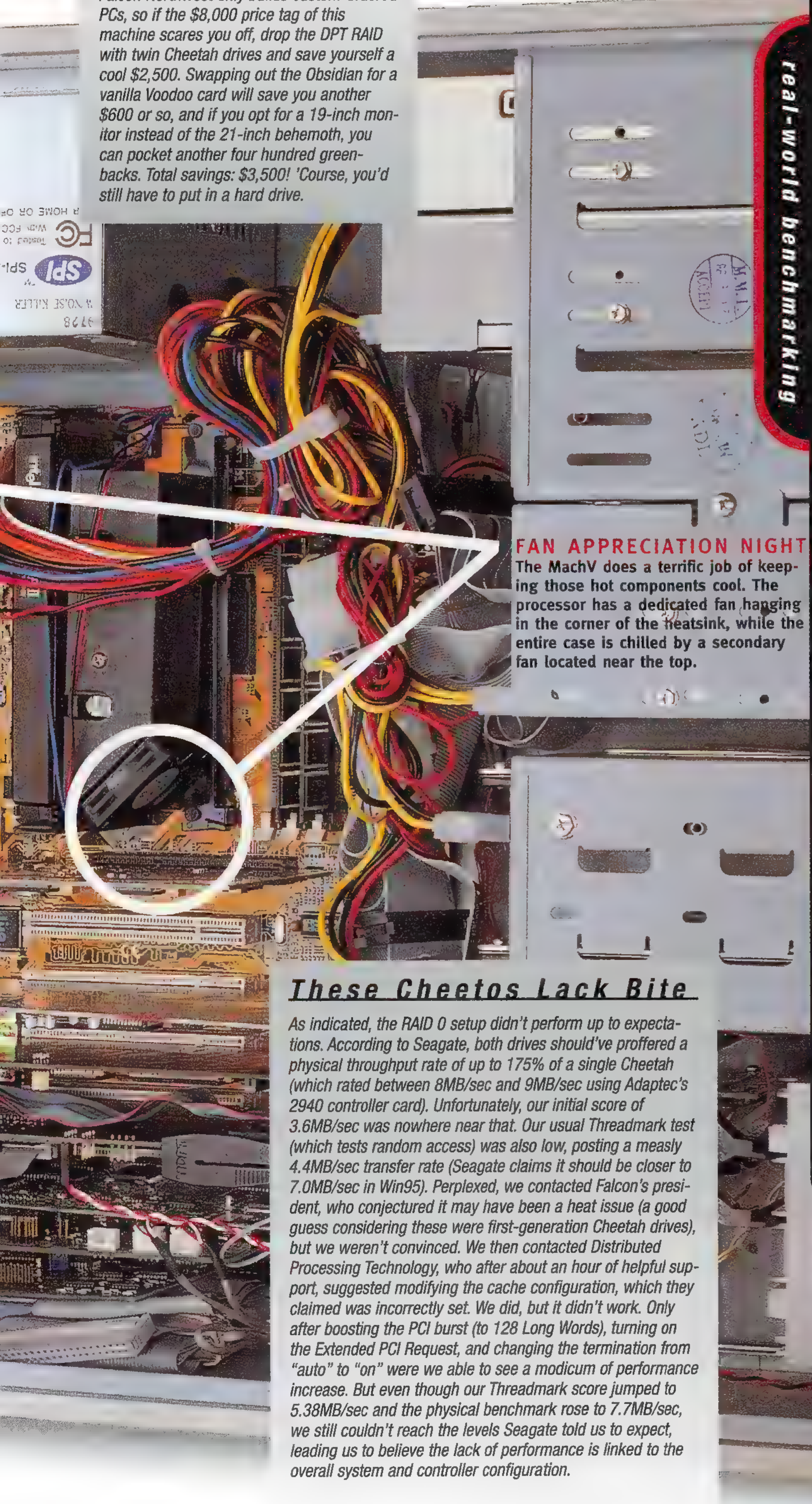
640x480 | 60 Hz
☐ Wait for Vertical Retrace
☑ Enable SLI Mode
Glide Settings
☐ Override Application Setting
Refresh Rate 60 Hz
☐ Wait for Vertical Retrace

GL CHEATS

Let's face it—50fps+ in *GLQuake* is mighty fine. If you turn off the "wait for vertical retrace" setting you can bump up past 70fps. But beware! You run the risk of tearing and other visual defects if you do.

Priced To Sell

Falcon Northwest only builds custom-ordered PCs, so if the $8,000 price tag of this machine scares you off, drop the DPT RAID with twin Cheetah drives and save yourself a cool $2,500. Swapping out the Obsidian for a vanilla Voodoo card will save you another $600 or so, and if you opt for a 19-inch monitor instead of the 21-inch behemoth, you can pocket another four hundred greenbacks. Total savings: $3,500! 'Course, you'd still have to put in a hard drive.



Falcon Northwest

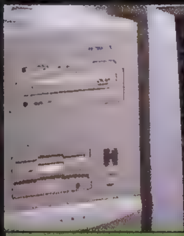
real-world benchmarking

	Test	Unit	MachV
CPU/MOTHERBOARD	bootMark		145.3
WIN95 APPS	SYSmark32		would not run*
DIRECT3D	Terramark	composite	126.1
HARD DRIVE	Adaptec ThreadMark v1.0	MB/sec	5.38
CD-ROM	CD Tach/Pro v1.65	K/sec	2892
WIN95 VIDEO	VidTach v1.52	% played	100
DOS GAMING	Quake v1.06	fps	31.6
DIRECTX GAMING	MDK PerfTest v1.4		130
MMX PROCESSING	DeBabelizer Pro	secs	208
CPU/DISK	Microsoft Visual C++ compile	secs	102

FAN APPRECIATION NIGHT The MachV does a terrific job of keeping those hot components cool. The processor has a dedicated fan hanging in the corner of the heatsink, while the entire case is chilled by a secondary fan located near the top.

These Cheetos Lack Bite

As indicated, the RAID 0 setup didn't perform up to expectations. According to Seagate, both drives should've proffered a physical throughput rate of up to 175% of a single Cheetah (which rated between 8MB/sec and 9MB/sec using Adaptec's 2940 controller card). Unfortunately, our initial score of 3.6MB/sec was nowhere near that. Our usual Threadmark test (which tests random access) was also low, posting a measly 4.4MB/sec transfer rate (Seagate claims it should be closer to 7.0MB/sec in Win95). Perplexed, we contacted Falcon's president, who conjectured it may have been a heat issue (a good guess considering these were first-generation Cheetah drives), but we weren't convinced. We then contacted Distributed Processing Technology, who after about an hour of helpful support, suggested modifying the cache configuration, which they claimed was incorrectly set. We did, but it didn't work. Only after boosting the PCI burst (to 128 Long Words), turning on the Extended PCI Request, and changing the termination from "auto" to "on" were we able to see a modicum of performance increase. But even though our Threadmark score jumped to 5.38MB/sec and the physical benchmark rose to 7.7MB/sec, we still couldn't reach the levels Seagate told us to expect, leading us to believe the lack of performance is linked to the overall system and controller configuration.



If you have the money to spare the MachV offers just about everything your little heart desires. However, this particular orbital configuration still needs some serious tweaking.

+

- Chart-busting performance
- Pentium II-300MHz
- High-end components
- GLQuake is fast as hell
- Good flight-sim controller
- Completely customizable to reduce price
- Speaker system

-

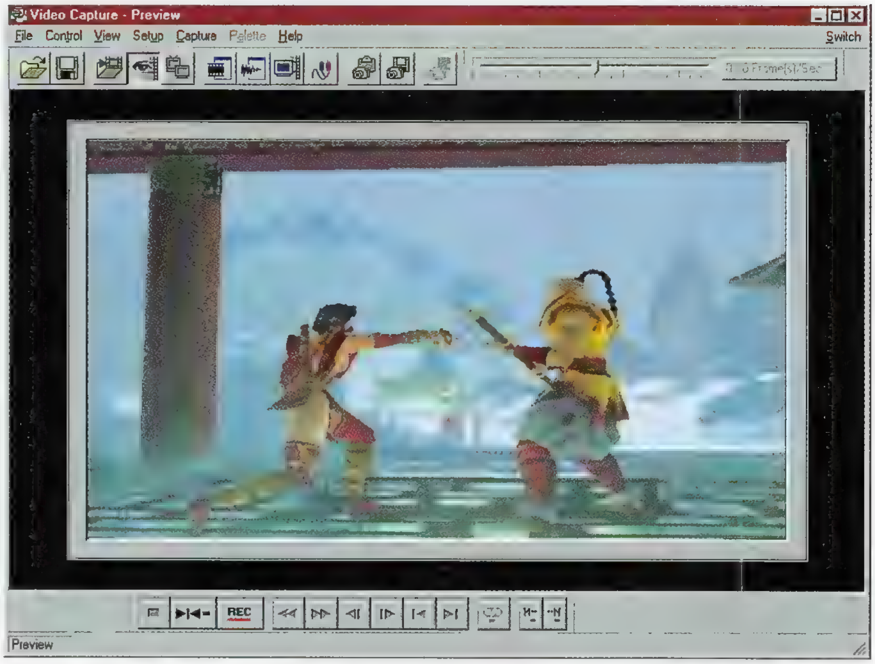
- Funky RAID configuration and performance
- Only one free slot
- No software bundle
- DVD-ROM visual quality
- No ergo keyboard
- No multiplayer gamepad
- Far-out price point
- Gamecard doesn't work with digital controllers

Price *$7,995*
Company *Falcon Northwest*
Phone *888.325.2661*
URL *www.falcon-nw.com*

boot verdict 8

MediaStudio Pro 5.0

All things to all people

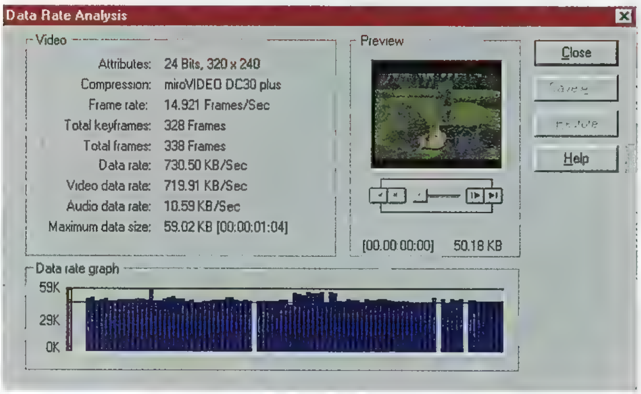


Capture any video source (ours is a PC running hardware-accelerated Mace*) directly into* MediaStudio Pro.

MediaStudio Pro is a robust, more fully featured application than Adobe's *Premiere*. When you combine the sheer number of features, such as the new *Video Paint* application, the audio editor, and the well-developed character generator, you have all the fixings to satisfy any budding multimedia producer.

MediaStudio's video-editing interface is similar to *Premiere*'s. Its feature set includes 101 video tracks, 101 audio tracks, 99 levels of undo, 109 transitions, real-time previewing, and "changes only" rendering, plus virtually everything is keyframable. And while *MediaStudio* now has plug-in support for MetaCreation's *Powertools*, Synergy's *HollywoodFX*, and Artel Software's *BorisFX*, what separates this app from *Premiere* are the value-added mini-applications included in the base sticker price.

The most welcome addition is *Video Paint*, which is worth the price of the package itself. This stand-alone application lets you import AVIs and perform such rotoscoping tasks as wire removal and/or bluescreen/color correction. To do this with *Premiere*, you'd have to save your movie as a filmstrip, then import that into *Photoshop*, which will set you back another $600. Once you import your video clip, each frame appears in chronological order on the bottom of the screen. The first frame appears larger in the work area above the timeline. At your disposal are a clone tool for doing quick repair work and an onion-skinning feature that lets you view a dimmed version of the previous frame. This is ideal for frame-by-frame animators. The image-editing capabilities aren't as well-rounded as *Photoshop*, but what *Video Paint* lacks in features it makes up for in speed and ease of use.

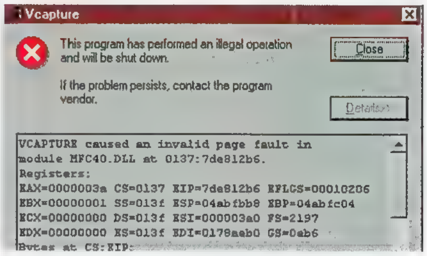


Attributes: 24 Bits, 320 x 240
Compression: miroVIDEO DC30 plus
Frame rate: 14.921 Frames/Sec
Total keyframes: 328 Frames
Total frames: 338 Frames
Data rate: 730.50 KB/Sec
Video data rate: 719.91 KB/Sec
Audio data rate: 10.59 KB/Sec
Maximum data size: 59.02 KB [00:00:01:04]
[00.00:00:00] 50.18 KB

Powerful tools allow you to pinpoint your video-capture performance.

Also included is an audio editor. While it's not as comprehensive as Sonic Foundry's *Sound Forge*, it does let you do some basic editing. You can drag and drop WAV files onto the timeline, add reverb and pitch, adjust your pan controls, and fix sync issues. You can zoom in, highlight a segment that needs work, and perform insert edits. Most importantly, there are plenty of shortcut keys. The bad news is that there's only one level of undo.

Another added bonus to the *MediaStudio* package is the incorporation of CG Infinity, a highly refined character generator. CG is an intuitive vector-based character generator for creating titles and motion graphics for video overlays. It includes the ability to apply motion to your text or objects, and adjust drop shadows, transparency, edges, and color. CG is fully anti-aliased and supports all TrueType fonts.



This program has performed an illegal operation and will be shut down.

If the problem persists, contact the program vendor.

```
VCAPTURE caused an invalid page fault in
module MFC40.DLL at 0137:7de812b6.
Registers:
EAX=0000003a CS=0137 EIP=7de812b6 EFLGS=00010206
EBX=00000001 SS=013f ESP=04abfbb8 EBP=04abfc04
ECX=00000000 DS=013f ESI=000003a0 FS=2197
EDX=00000000 ES=013f EDI=0178aeb0 GS=0ab6
Bytes at CS:EIP:
```

While MediaStudio*'s video-capture features are hardy, when things get ugly they get* very *ugly.*

While *MediaStudio* has made a spectacular leap from the previous 2.5 version, constantly toggling back and forth between all of the mini-applications can suck up your RAM. We'd like to see them all incorporated into the main program. Still, this minor annoyance doesn't overshadow all the pluses.

—Rick Popko

Price $595
Company Ulead
Phone 800.858.5323
URL www.ulead.com

boot verdict 9

Quake II

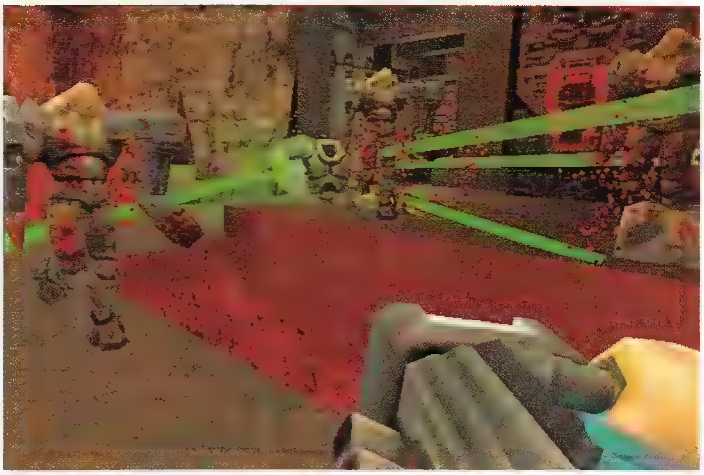
Premature e-quake-ulation

Quake II is pure unadulterated sex gliding across your 3D accelerator. Enticing you with an intricately modeled environment mapped with 8-bit textures, the game dazzles with an astoundingly realistic physics model and plies you with enough colored lighting to make you giddy. Then it heaps on the intense first-person action at mind-blowing frame rates.

Like any good sex, *Quake II* is a little sloppy. A host of bugs plague the shipping version, with sticky walls and incomplete multiplayer code being the most offensive. While many of the bugs have been addressed with subsequent patches, it'll be a while before *Quake II* is as robust as its predecessor. Perhaps Activision should modify the *Quake II* ads to read, "It's done enough."

New to the game is an inventory system that allows selective use of items such as quad damage and powered armor, as well as a mission-based storyline with CG cutscenes that upgrades the single-player *Quake* experience with an actual plot. Of course the cutscenes would've been even more impressive if they were done with the game engine.

With a graphical environment surpassing anything seen on the PC, id could easily be forgiven for releasing *Quake II* early (especially since they're working so diligently to patch it up). Particle and transparency effects are put to good use in explosions as well as in power shields, and come together beautifully in weapons' fire such as the railgun's devastating corkscrew. Radiosity lighting brightens dark corridors with 16-bit colors, and procedural textures map bloody wounds across the enemies with each hit they take. With a 3Dfx card, the frame rate rarely dips below 22fps. For those of you sadly denied an OpenGL-capable 3D card, the software renderer pulls off everything but the colored lighting, but it does so at the cost of playable frame rates.



Quake II*'s BFG lights up the enemies with devastating effect.*

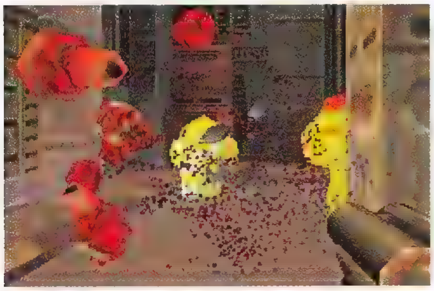
CHECKLIST

Quake 2	
Version:	1.0
Maximum Resolution/Color	1600x1200/16-bit
Win95 Native	
WinNT Compatible	
3D Acceleration	OpenGL
Multiplayer	TCP/IP

Oh my God, they killed Kenny! You bastards!

Besides the increased detail in the texture maps, *Quake II* boasts higher polygon counts than the original, bringing more graphic realism to the enemies (around 600 polys each). The graphics engine furthers the realism by interpolating the ten frame animations into smoother motions. Each enemy has a distinct attack pattern and reacts when fired upon, either by ducking, running, or firing back. The AI is far from perfect, but it's a step in the right direction. Enemy death scenes vary from the mere faceplant, to the flop to the ground and struggle to get back up, to the uncontrollable release of random gunfire before they fall, although the gibbed chunks thrown off by exploding bodies are definitely not as cool as they were in *Quake*.

A well-designed physics model coaxes realistic reactions out of the enemies, depending on where damage is inflicted. Explosions produce knockback, the railgun blows enemies off their feet, and close-range shotgun blasts cause them to spin. Weapons animations are better also, and each weapon exhibits its own quirk, such as the recoil caused by a heavy spray of machine gun fire and the long pause while another rocket or grenade is loaded into the chamber.



The gibbed chunks are not as dazzling as Quake*'s.*

Meet and kill exciting new enemies in this installment.

Great attention has been paid to *Quake II*'s sound effects, and the 22KHz samples (they can be lowered to 11KHz for better performance) enhance the game's immersiveness. Particularly notable is the hum from the BFG and the metallic ricochet of bouncing grenades, as well as the ambient sounds of the torture chamber (it hurts, make it stop) and bone crunching of the human processing plant. But the relentless female voice announcing "computer updated" is annoying and unnecessarily repetitive.

Multiplayer is limited to TCP/IP, and performance isn't as consistent as in *Quake*. Co-operative play and capture the flag were dropped in order to make the game's targeted ship date, and they're sorely missed.

Despite the few small shortcomings, id has once again produced the ultimate first person shooter engine that'll run beneath a whole new generation of games. Hopefully they'll also produce enough bug fixes and enhancements to allow the game to reach its full potential.

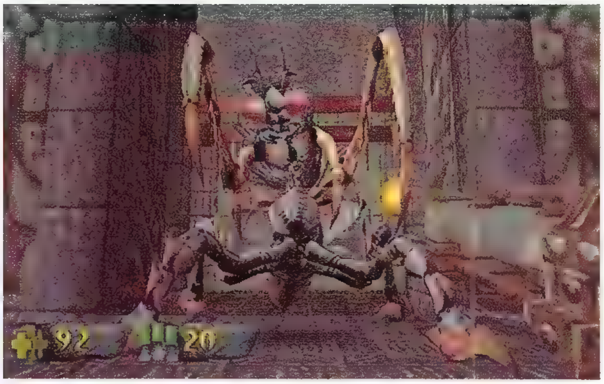
—Sean Downey

Price *$40*
Developer *id Software*
Publisher *Activision*
Phone *800.477.3650*
URL *www.activision.com*

boot verdict
9

Turok **Dinosaur** Hunter

Dead dinosaurs need not apply



Destroy those saurian terrors in this fine conversion of Turok Dinosaur Hunter.

True to the original N64 *Turok*, texture-mapped dinosaurs and motion-captured bad guys try in vain to 187 poor Turok, but darn that guy if he doesn't pack the most awe-inspiring firepower.

The engine driving *Turok* renders texture-mapped terrain with frame rates ranging from 24fps on up—but at a price. Like its cartridge-based counterpart, *Turok*'s fog bank hides terrain fill-in. At least the terrain that is visible looks as good as its console cousin, even better with the right 3D accelerator. Running in a higher resolution than the N64 version makes this *Turok* look sharper. The blood flies fast and furious, with fatal arterial wounds procedural texture-mapping the scenery, while monsters killed underwater tint the water crimson. Most excellent. Unfortunately, your fallen foes "dissolve" in an unrealistic *Tron*-esque effect (no doubt to keep on-screen polygons to a minimum).

The weapon animation and alpha-blended weapon effects are well implemented. Swimming underwater and climbing are handled more realistically here than in *Quake II*.

Unfortunately, many of *Turok*'s gameplay mechanics reek of a console birthing, such as the collection of force gems to gain additional lives, similar to *Sonic*. And how about the "find-the-spot-to-save" nonsense? Thankfully, the control is tight and responsive; the mouse/keyboard combo works best.

First-person shooter purists may scoff at all the jumping and collecting *Turok* is forced to endure, but when the dust settles, *Turok Dinosaur Hunter* is a top-notch conversion of the N64 classic and a refreshing change of pace from the dark, corridor-bound worlds *Quake* and its children are spawning.

—*Andrew Sanchez*

CHECKLIST
Turok Dinosaur Hunter
Version: 1.0
Maximum Resolution/Color
640x480/16-bit
Win95 Native
3D Acceleration
Direct3D
Native 3D Hardware Support
3Dfx Glide

Price *$50*
Developer Iguana Studios
Publisher Acclaim
Phone 516.656.2456
URL www.acclaimnation.com

boot verdict 8

TRY IT ON THE DISC

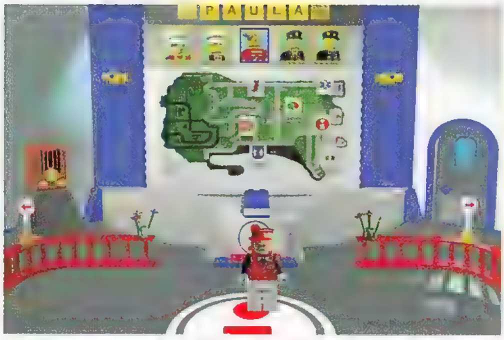
A Benchmark is Born

This month's bootDisc demo of Turok *has a built-in benchmark that spews out an average fps score. Accessing this benchmark is simple: after installing the demo, create a shortcut, go to the shortcut's properties, and under the filename add the command* `-benchmark` *after the Turok.exe.*

Fire it up, and you'll get your average fps listed in the top-center of the screen.

Lego Island

Leggo my Lego



Your journey into Lego Island *starts at the Information Center.*

Remember Saturday afternoons building Lego cities? You'd build hospitals, cars, skyscrapers, computer stores (OK maybe that was just us). Mindscape remembers and has brought Legos to the PC. But with the steep requirements, your five year old just might start screaming "upgrade."

Lego Island features an entire 3D Lego world rendered in real time for your little power-user-in-training to explore. There are building activities, vehicles to race, Lego people to interact with, and even a bad guy, the "Brickster," to catch and put in jail. While all this sounds like fun, the game just doesn't have the same appeal as a big bucket of Legos.

There's no justifiable reason for the high requirements this game carries. The 3D is primitive at best and runs only in 8-bit at 640x480. There is no dynamic light sourcing, Gouraud shading, or anti-aliasing—all of which would have helped to make the world nicer to look at. As you get close to objects, giant pixels appear; maybe each one is supposed to be a separate Lego. Texture mapping is used, but only to animate the faces. The game automatically scales itself to your machine, but even on P200 MMX with a Voodoo card and all options turned on, we didn't see anything to write home about. The game doesn't look awful; it just doesn't measure up to today's standards. The music and sound effects are fun, with DirectSound 3D support being one of the few aspects of the game deserving high praise.

Although this game can be mildly amusing at times, a big tub of real Legos is a much better investment.

—*Paula Reaume*

Ladies and gentlemen, start your engines please.

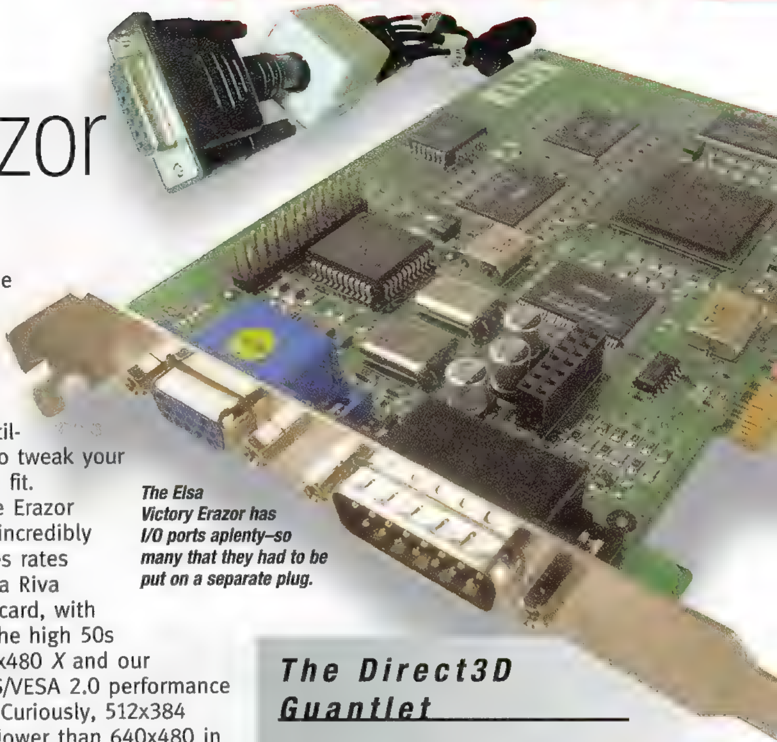
CHECKLIST
Lego Island
Version: 1.0
Maximum Resolution/Color
640x480/8-bit
Win95 Native
3D Acceleration
Direct3D
DirectX
DirectSound DirectPlay
DirectInput

Price *$40*
Company Mindscape
Phone 800.287.3800
URL www.mindscape.com

boot verdict 4

Elsa **Victory** Erazor

A close shave



The Elsa Victory Erazor has I/O ports aplenty–so many that they had to be put on a separate plug.

Elsa is the latest to fall under the Riva 128's benchmark breakin' ways with its Victory Erazor board.

Sporting all the characteristics of nVidia's Riva 128, the Erazor's pint-size PCI formfactor sports 4MB of nonupgradable 100MHz SGRAM, a 230MHz RAMDAC, integrated triangle set-up engine, and onboard texture cache. A 1x AGP part is also available.

OpenGL Quake-o-rama

Quake/GL Performance

GLQuake	(512x384)	33.8fps
	(640x480)	29.9fps
	(800x600)	n/a
GLHexen 2	(512x384)	13.5fps
	(640x480)	13.4fps
	(800x600)	11.2fps
GLQuake II	(512x384)	33.8fps
	(640x480)	14.3fps
	(800x600)	12.7fps

- *GL mini driver version Alpha 2 Build 258. This rev, at the time of writing, is still in an alpha stage. Expect optimizations to occur as time goes on.*
- *DEM file used: GLQuake=bootmark.dem; GLHexen 2=demo2.dem; GlQuake II=demo2.dm2*

In a bid to outdo Canopus's excellent Total3D 128V, the Erazor comes with a single S-Video and composite input, and dual composite and lone S-Video outputs. This massive bundle of I/O connectors is wired into a 15-pin connector that in turn hooks up to the Erazor. Like the Total3D 128V, the Erazor's BIOS is tweaked, so if you have only the TV hooked up, it'll automatically bump your Win95 resolution down to 640x480/60Hz. The SVideo/composite output is clean—unfortunately you can't have the monitor and TV going at the same time like you can with the Total3D 128V.

Installation is a snap, with Elsa's WINman desktop utilities allowing you to tweak your desktop as you see fit.

As expected, the Erazor spewed out those incredibly fast Direct3D frames rates you'd expect from a Riva 128—armed video card, with scores ranging in the high 50s to low 60s on 640x480 *X* and our ForsakenMark. DOS/VESA 2.0 performance is also pretty fast. Curiously, 512x384 frame rates were slower than 640x480 in our *Turok* and ForsakenMark tests. We ran the benchmarks three times, but the scores remained. As a rule, Riva 128 cards scale with a faster processor, but you still get good performance on a P200 CPU. The Visual quality, like all Riva 128 boards, is an acquired taste: you either don't notice the speckled dithering textures or you don't care, so we won't beat you over the head with this subject. With the latest drivers in tow (v2.02), that accursed transparency problem in *Jedi Knight* has finally been solved—nVidia is aware of this, and other Riva 128 boards should also have newer drivers available to fix this problem. Alpha-blending problems in *Forsaken* result in semi-transparent boxes showing up around weapon effects and objects—this shouldn't be the case with most D3D games, but they were noticeable.

The mini-GL drivers currently available as of this writing are in a late-alpha stage of development and far from final, but nVidia was kind enough to put those drivers out for the hordes. Changing your entire Win95 driver set to nVidia's reference drivers gains access to GL games such as *Quake* and its ilk. Performance under *Quake II*, *GLHexen 2*, and *GLQuake* are above average, although the dithered visual quality leaves something to be desired. Again, as time progress, expect nVidia to optimize for better performance.

The Riva 128 market is getting crowded, and Elsa's sub-$200 feature-rich and benchmark-blasting video card is compelling. But, when you compare it with Canopus's Total3D 128V, the Erazor comes in a close second.

—*Andrew Sanchez*

Feature Set and 2D Performance

Max 24-bit resolution/refresh	1152x864/75Hz *32-bit
Max 16-bit resolution/refresh	1600x1200/75Hz
VESA 2.0 Support/BIOS flashable?	YES/YES * VESA 3.0
Virtual Desktop Support	No
DOS Quake (320x240)	72.3fps
DOS Quake (640x480)	30.3fps
DOS Quake (800x600)	21.7fps
MDK PerfTest v1.4 (DirectDraw)	125
Final Reality Radial Blur (DirectDraw)	29.77fps
Final Reality Chaos Zoomer (DirectDraw)	46.97fps

Note: All performance results were obtained under the following system configuration. COMPUTER: Micron Millennia XRU; CPU: Intel Pentium II 300MHz; O/S: Windows 95 OSR2.1 Build 1212b; Motherboard: Intel AN440 440LX AGPset (1 AGP, 2 PCI, 2 ISA, 1 PCI/ISA shared

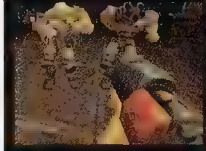
The Direct3D Gauntlet

Direct3D Performance	
ForsakenMark (512x384)	44.92fps
ForsakenMark (640x480)	64.35fps
ForsakenMark (800x600)	55.13fps
ForsakenMark (1024x768)	failed
X (640x480)	58.21fps
X (800x600)	49.31fps
X (1024x768)	38.92fps
Turok (512x384)	59.2fps
Turok (640x480)	53.9fps
Turok (800x600)	39.3fps
Final Reality 25Pixel	208.70Kpoly/sec
Final Reality Fill Rate	60.87Mpixels/sec

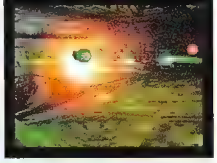
Elsa Victory Erazor

Visual Quality

***Quake II*/Open GL**



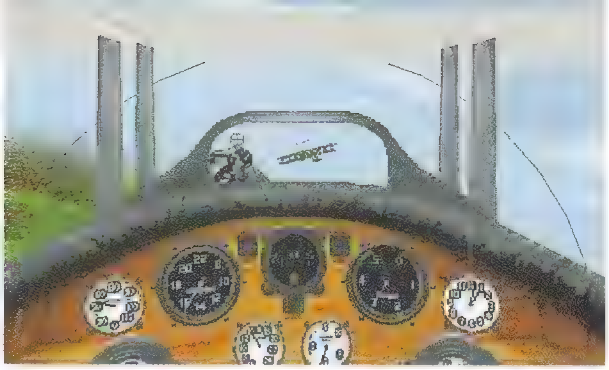
***Forsaken*/D3D**



THE STATS: BIOS: 1.47.01 I Win95 drivers: 2.02 ***THE BUNDLE:*** Win95 Drivers

Price *$199*
Company *Elsa*
Phone *800.272.ELSA*
URL *www.elsa.com*

boot verdict
7



Red Baron II's virtual-cockpit view tracks enemies. The instruments are functional, but low-res.

Red **Baron** II

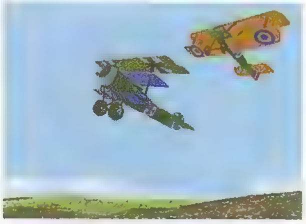
The Fokker flies again

CHECKLIST
Red Baron II
Version: 1.0
Maximum Resolution/Color
640x480/256-bit
Win95 Native
3D Acceleration
OpenGL
DirectX
DirectDraw DirectSound
DirectPlay DirectInput
Multiplayer
LAN Modem Direct/serial
TCP/IP
Specialty Controllers
Force feedback
Throttle Rudder

After years on the drawing board, *Red Baron II* is still a work in progress. This update of the classic World War I simulation has good gut-level design but is implemented using spit and baling wire, just like the propeller-driven crates featured in the game

Visuals look sharp, thanks to the 3Space graphics engine. Aircraft use 200 to 250 polygons each and feature intricate textures. You can import your own bitmaps to jazz up your craft.

Given the historical locale, terrain is mostly flat. However, the view is enlivened by a few rolling hills and well-crafted texture effects, based on 256x256 tiles. You'll see lots of big square pixels when you get up close, but from as little as 100 feet up the effect is likable.



Action is fast when Fokker DR-1 meets its nemesis, the Sopwith Camel.

The Win95 DirectX implementation includes support for force feedback, and Microsoft's SideWinder Force Feedback Pro warns of impending stalls and jolts nicely when tracers hit you in the back. Unfortunately, you can't reconfigure your controller.

Too bad all this good stuff is sabotaged by awkward elements. The most immediate downer is lack of 3D acceleration. With all the graphic options maxed out, nothing less than a serious Pentium II is likely to coax frame rates into double digits.

Subtler but more deadly problems arise from the incomplete viewing and control facilities. Red Baron II gives you a cool virtual-cockpit view, but omits onscreen attitude indicators. so when you enable the free-looking enemy-padlock view it's even money whether you rip the wings off before you actually hit the ground.

Luckily, Dynamix knows that all is not well. A patch is impending to squash the bugs and add a more realistic flight model. A 3D accelerator update is expected by spring.

With just a bit more hangar time, *Red Baron II* could easily become the sim that WWI aviation buffs have been waiting for.

—Frank Lenk

Price ***$55***
Developer ***Dynamix***
Publisher ***Sierra On-Line***
Phone ***800.757.7707***
URL ***www.sierra.com***

boot verdict 6

Flying **Corps** Gold

Sputtering into the wild blue yonder

CHECKLIST
Flying Corps Gold
Version: 2.0
Maximum Resolution/Color
800x600/256-bit
MS-DOS Executable
Win95 Native
3D Acceleration
Direct3D
DirectX
DirectDraw DirectSound
DirectPlay
Multiplayer
LAN Modem Direct/serial
TCP/IP
Specialty Controllers
Force feedback
Throttle Rudder

Even after a rebuild, *Flying Corps Gold* still seems like the work of talented amateurs, a rickety DOS-based WWI simulator that sabotages its own flashes of genius.

Flight models are particularly sharp, allowing fancy maneuvers like spins and snap rolls. Battle damage is also well simulated, and campaigns range to authentic possibilities.

A floating wireframe in the virtual-cockpit view shows your attitude when your head is twisted, and a joystick button instantly centers the view. Enemy-pilot AI has been tweaked and is downright vicious. Also new are two more aircraft and a mission editor.

Unfortunately, the sim's creaky DOS heritage remains painfully apparent. Catastrophic system crashes are as much of a danger as enemy aces, and the game runs smoothly only after a complete system restart. Last-minute texture loading often brings your campaign to a fiery conclusion.

Some glaring faults of the original *Flying Corps* remain in the Gold edition. Most obvious is the gruesome installer, which lets you enter an alternate game directory then issues a nasty error message if you dare try it.

Manual joystick calibration is another throwback. Force feedback is supported only on the outdated CH Force FX. However, a proper DirectX 5 driver for the SideWinder Force Feedback Pro should be available soon.

Flying Corps Gold's *virtual cockpit is smoothly done.*

Although 3D acceleration pushes color depth from 8- to 16-bit, it does more for frame rates than for aesthetics. On an aging P166 armed with a Canopus Pure3D accelerator, frame rates blasted from under 1fps to a flyable 18fps with acceleration enabled.

Aircraft textures were excellent to begin with and look spiffy with accelerated smoothing, despite the fairly limited number of polygons. But the terrain looks like one big polygon: a rectangle with a blurry aerial photograph pasted on it. The few hills are so low that you'll notice them only during an off-field landing.

Obviously, enough would-be WWI flyers enjoyed the original *Flying Corps* to justify the minor Gold update. But until this sim gets a ground-up Win95 rewrite, it will appeal mainly to the hardiest of the hard corps.

—Frank Lenk

Price ***$40***
Developer ***Rowan Software***
Publisher ***Empire Interactive***
Phone ***800.610.4847***
URL ***ww.empire-us.com***

boot verdict 5

AD INDEX

COMPANY	URL/PHONE #	PAGE NUMBER	PRODUCT INFO NUMBER
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Ocean of America	www.oceanltd.com	26	261
Real 3D	www.real3d.com	20	117
Sejin America, Inc.	www.sejin.com	28	30
Softman Products	www.cheapsoftware.net	95	313
Sony Electronics, Inc.	www.sony.com/technology	22-23	—-

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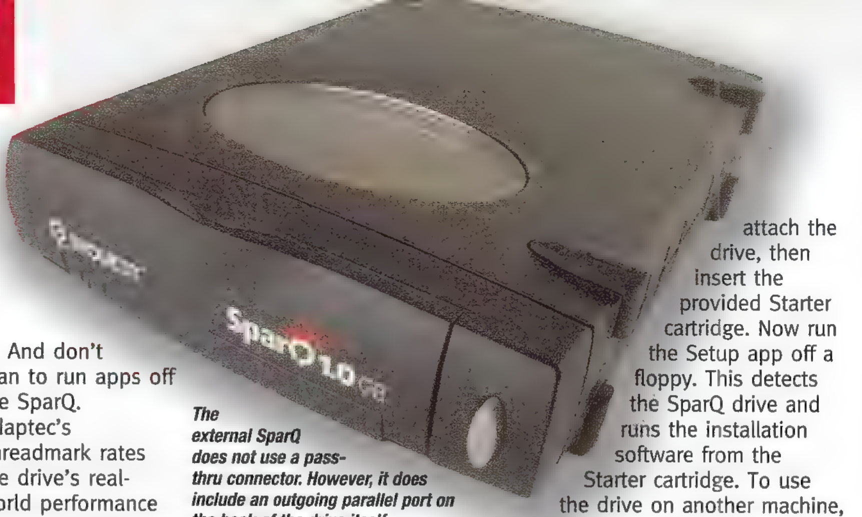


The external SparQ does not use a pass-thru connector. However, it does include an outgoing parallel port on the back of the drive itself.

SyQuest, veterans of the removable-media wars, are back with the Jaz-killer they hope will turn the tides in the battle for 1GB cartridges drives. The SparQ emphasizes inexpensive portability and delivers on both grounds. Unfortunately, the parallel port interface delivers a potent performance hit, especially compared with the SCSI-based Jaz.

Using the EPP (Enhanced Parallel Port) protocol, the SparQ promises "hard drive" speeds of 12ms, but delivers 22.9ms access times. Read and burst speeds fell dramatically short of the promised 1.25MB/sec read and 2.0MB/sec burst rate, with both averaging 850K/sec. Although parallel port performance varies with processor speed, we tested the SparQ on a 266MHz Pentium II. On a lesser system, you should expect even lower scores.

Dare to Compare

	SparQ	Jaz
Interface	EPP	SCSI
Access Time	22.9ms	20ms
Read	850K/sec	5.2MB/sec
Drive (ext.)	$200	$400
Cartridges	$40	$100
Capacity	690MB	734MB
Fill Time	23min	21min

At $40 each, or three for $100, SparQ cartridges are a bargain.

And don't plan to run apps off the SparQ. Adaptec's Threadmark rates the drive's real-world performance at only .66MB/sec. And CPU utilization hovers at 88%! With numbers like these, the SparQ should be used only for backup purposes.

But take the promised 1GB capacity with a grain of salt. Tossing a full gig into the SparQ proved fruitless, as the cartridge filled at 690MB, due to file-system overhead.

Although the SparQ comes with a cartridge, this media is nearly full (728MB), with required installation software and utilities to format, duplicate, back up, configure, and mount/unmount cartridges. And we had problems getting the utilities to even run on our test systems.

Also be aware that the SparQ is not PnP. It requires a proprietary device driver that must be installed through an elaborate process. First you attach the drive, then insert the provided Starter cartridge. Now run the Setup app off a floppy. This detects the SparQ drive and runs the installation software from the Starter cartridge. To use the drive on another machine, the process must be repeated.

There's no doubt the SparQ has definite advantages over Iomega's ubiquitous drives (whose huge installed base is an advantage when it comes time to share files), price being foremost. With a price half that of the Jaz and cartridges that can be bought in a three-pack for the cost of a single Jaz cartridge, the SparQ has appeal as an expandable offline storage device. SyQuest also offers an internal IDE version of the SparQ, which raises the performance level somewhat, but at the cost of portability.

You'll have to decide if the trade-offs work for your needs.

—Sean Cleveland

Price $200 (additional cartridges $40, 3/$100)
Company Syquest
Phone 510.226.4000
URL www.syquest.com

boot verdict 6

Platinum **Sound** SWX-1600

Where's the bass?

Building a speaker system is more than just slapping cones into a high-tech box and claiming massive power ratings, and the Platinum Sound SWX-1600 is a picture-perfect example of that.

The SWX-1600 is a three-piece subwoofer/satellite combo consisting of a single 5.25-inch woofer housed in a single-reflex bandpass box made of half-inch high-density particleboard. The integrated amplifier claims 160-watts of "peak" power (yeah right), while all your inputs and outputs are located behind the box. Inside each sealed satellite (raised via metal stands) lives a 3-inch midrange speaker.

As expected, the SWX-1600's bandpass box excited bass energies around a specific region, from 70Hz to about 90Hz, with output rapidly rolling off either way. While the woofers hardly gave any indication of being overdriven, explosions and anything low-frequency-related were not impressive at all. Even with the volume turned up, the sub could not do any damage, lacking deep punch or snap.

Despite the low price and compact size, the Platinum Sound SWX-1600 joins the ranks of other substandard speakers out there.

The mids also suffer, sounding muddy and lacking brilliance or treble sparkle. While left/right stereo separation is good, center-channel imaging is weak. To add to the trouble, the satellites take way too much bass energies.

The low-end market is filled with awesome speaker sets—the Platinum Sound SWX-1600 is not one of them.

—Andrew Sanchez

Price $99.95
Company Platinum Sound
Phone 800.408.4084
URL www.platinumsound.com/plat.html

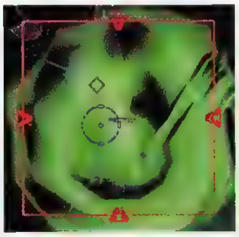
boot verdict 3

Wing **Commander** Prophecy

A solo saga

In *Wing Commander Prophecy*, you'll dish out that can of intergalactic whip-ass with authority, and you'll do it with the best graphics ever seen in a first-person space-combat simulator.

"Awesome" is too mild a word to describe *Prophecy*'s lush visuals. How does "supercalifragilistically spectacular" sound? Origin's aging RealSpace graphics engine (last seen powering many of Origin's flight sims) has finally been put in dry-dock. In its place stands the Vision engine—a 32-bit SVGA engine capable of rendering some of the most intense visuals ever seen in a space-combat sim. Texture-mapped, light-sourced polygons adorn the starscape, with alien ships turning and burning. While Origin tossed in a software renderer, it's only when you pipe *Prophecy* through Direct3D or Glide that it truly shines. Many of the special effects, such as the shock wave explosions, lens flares, colored lighting, and alpha-blended sprite glows and shield effects, scream for attention but the details make themselves known only after you've played a few missions. The polygon cockpit that shakes violently when hit, the Glide-specific nebulous starfields, and the color Communications video (a first for the series) are among the many cool nuances. The Vision engine is capable of on-the-fly detail-level adjustment, resulting in silky smooth 24fps on a 3Dfx-enhanced P200. Even with a massive capital ship and a couple of bogies in full view, the frame rate hardly wavers—the only time it chokes is when many visual effects are active at once.



Prophecy ***uses the shockwave explosion to full effect—is it live, or is it Memorex?***

CHECKLIST

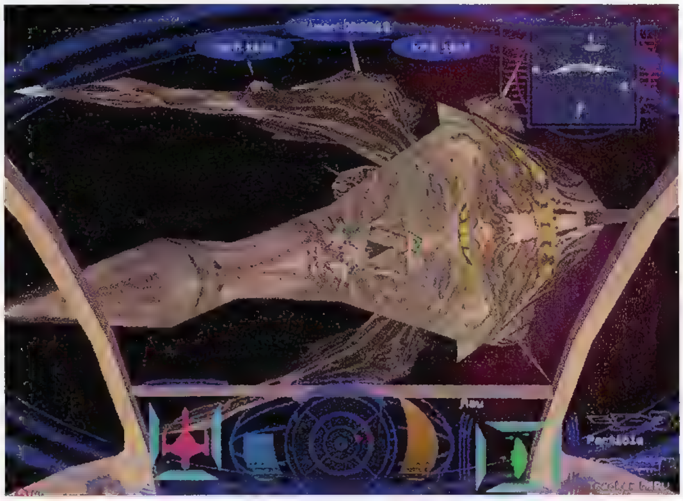
Wing Commander Prophecy
Version: 1.0

Maximum Resolution/Color
640x480/16-bit

Win95 Native

3D Acceleration
Direct3D

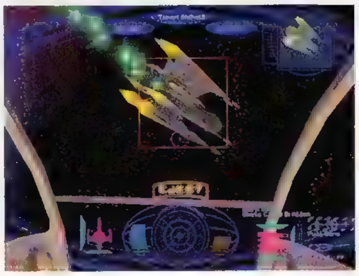
Native 3D Hardware Support
3Dfx Glide



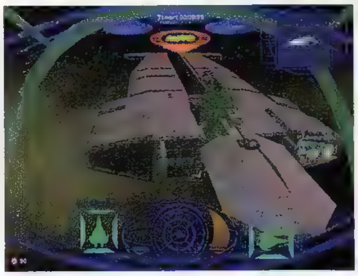
Wing Commander Prophecy*—an object lesson to LucasArts on how to make a real sequel.*

And those cap ships are huge—your own super carrier, the TCS Midway, is one massive starship, complete with animated polygon turrets. Everything looks like it was ripped from an episode of *Babylon 5* and made fully playable. While smaller fighters hurtle out of control to a fiery death, the capital ships unfortunately don't die as spectacularly as in *Wing Commander IV*. It's not as bad as *X-Wing vs. TIE Fighter*, but we've seen better.

Despite Origin's talk of getting back to sweat-inducing gameplay and moving away from a muy grande cinematic experience spanning five CDs, there is still a great deal of FMV in *Prophecy* (enough to fill three CDs). In fact, you spend almost as much time watching FMV antics as you do jockeying around in space lighting up alien starfighters. And unfortunately, the pixelated, lossy cinematics have taken a step back in visual quality—the FMV in *Wing Commander IV* looked a helluva lot cleaner and more colorful than this drab mess. Veteran Wing Commanders will notice the lack of binary Q&A throughout the FMV—decisions made on the battlefield will determine the FMV that follows. Also, the choice to interact (or not) with fellow pilots will also determine which cinematic plays.

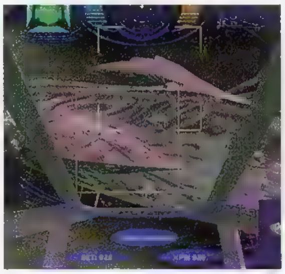


Line these aliens up and tear into them with a blast of hot plasma death.



The TCS Midway, in its entire texture-mapped polygon glory.

While some may call bunk on *Prophecy* for not shipping with its promised multiplayer capabilities, we're not holding that against Origin. After all, the *Wing Commander* experience has always been an epic, Wagnerian saga starring you as the main character, and multiplayer in this game would have cheapened the experience. You want multiplayer *Wing Commander*? Demand a sequel to *Wing Commander Armada* using the Vision Engine and wait, 'cause you're not getting it here.



Syd Mead provided his artistic vision when it came time to conjure up new alien lifeforms to destroy. The capital ships look suitably organic.

Although the FMV looks grainy when compared to previous cinematic ventures, *Wing Commander Prophecy*'s killer combo of joystick-breaking dogfights, drop-dead gorgeous graphics, and compelling storytelling makes this prophecy worth fulfilling.

—Andrew Sanchez

Price $50
Developer Origin Systems
Publisher Electronic Arts
Phone 800.245.4525
URL www.ea.com

boot verdict
9

Hercules' **Thriller** 3D and Jazz's **Outlaw** 3D

Rendition's V2200 hits the big times

You tasted Rendition's next-generation Vérité 2000 series 2D/3D processor a couple of months ago with Diamond's V2100-powered Stealth II S220. Finally, after some silicon delays, the V2200 makes its appearance.

Differences? Well, the V2100 is designed as an entry-level part clocked at 40MHz and using a slower 170 RAMDAC compared with the 2200. They all share the same characteristics as the V2000 TruMedia Accelerator, such as its highly programmable RISC core, integrated set-up engine, and full-featured 3D set. Among those features is the ability to perform single-cycle rendering of 12-attribute Direct3D pixels, 8-bit precision for bilinear filtering, trilinear filtering, and hardware-assisted anti-aliasing. All V2200 boards come armed with flash BIOS to upgrade when you see fit.

D3D and OpenGL (via mini drivers for all you Quake-heads), as well as Rendition's own RRedline and Speedy3D APIs are the V2200 APIs of choice. The V2100-powered Stealth II impressed the hell out of us with an all-in-one 3D video card that anyone can afford—let's see how Hercules and Jazz Multimedia handle its bigger brother.

—Andrew Sanchez

Quake/GL Performance

	Jazz Outlaw 3D	Hercules Thriller 3D
GLQuake		
(512x384)	37.1fps	40.1fps
(640x480)	27.2fps	30.0fps
(800x600)	n/a *	n/a *
GLHexen2		
(512x384)	16.2fps	23.8fps
(640x480)	12.8fps	19.3fps
(800x600)	9.6fps	14.3fps
GLQuake II		
(512x384)	26.3fps	29.6fps
(640x480)	20.2fps	23.5fps
(800x600)	14.2fps	17.6fps

** Refused to run on both cards*

- *GL mini driver version 0.1.1.*
- *This rev, at the time of writing, still had some graphic glitches when coupled with* Quake II. *For* GLQuake II, *we had to use the gl_flashblend 1 command in order to get the particle effects to appear correctly. Rendition promises a full-featured, optimized ICD driver for the V2x00 processor by the time you read this.*
- *DEM file used: GLQuake=bootmark.dem; GLHexen2=demo2.dem; GLQuake II=demo2.dm2*

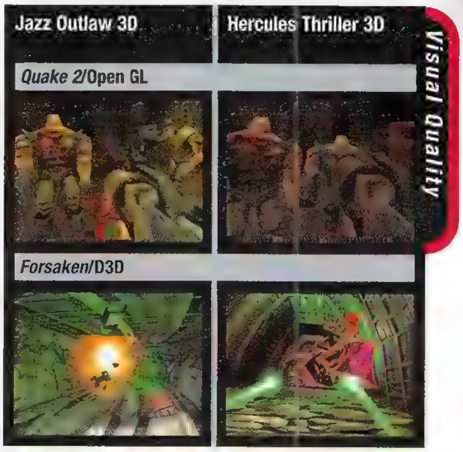
Jazz Multimedia **Outlaw** 3D

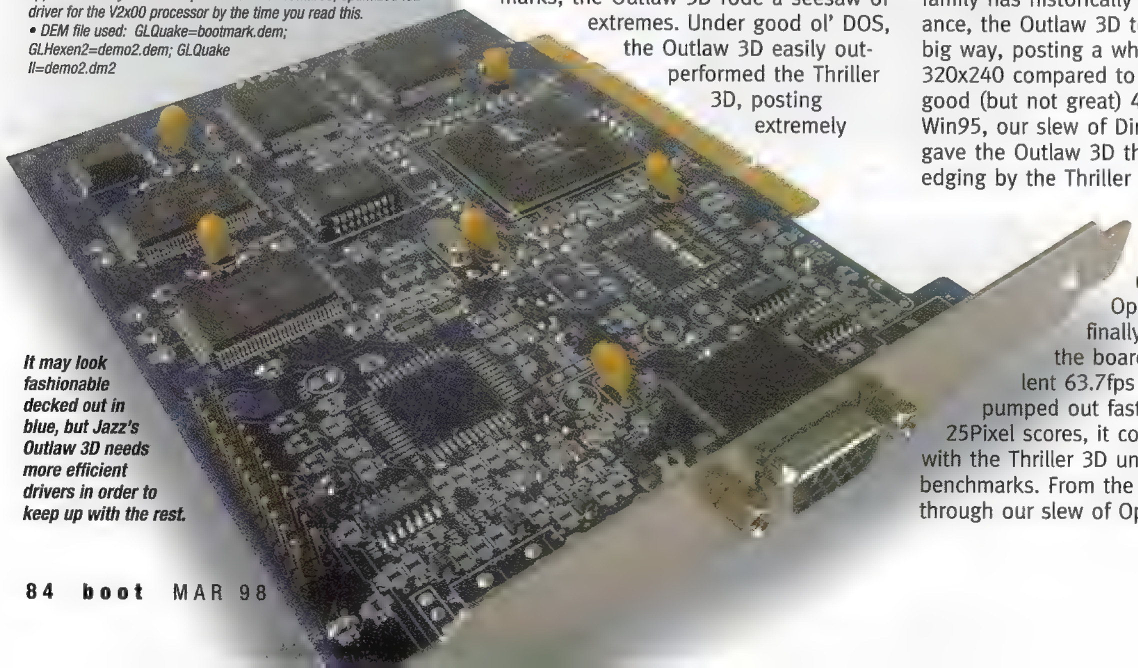
Sporting a cool cobalt blue circuit board, Jazz's Outlaw 3D is a no-frills Rendition V2200 board armed with 4MB of non-upgradable 100MHz SGRAM coupled with a 230MHz RAMDAC. Available in 4MB or 8MB bus-mastered PCI or AGP 1x/DMA configurations, the Outlaw 3D sits between the über-cheap Stealth II and the Thriller 3D in terms of features, so don't expect anything extra.

Drivers for Win95 and WinNT 4.0 are promised, but as of press time, only the Win95 drivers are available. While some may scoff at the lack of a game bundle, Jazz does provide the latest GL mini drivers for *Quake*-based gaming—expect a full, optimized ICD from Rendition by the time you read this.

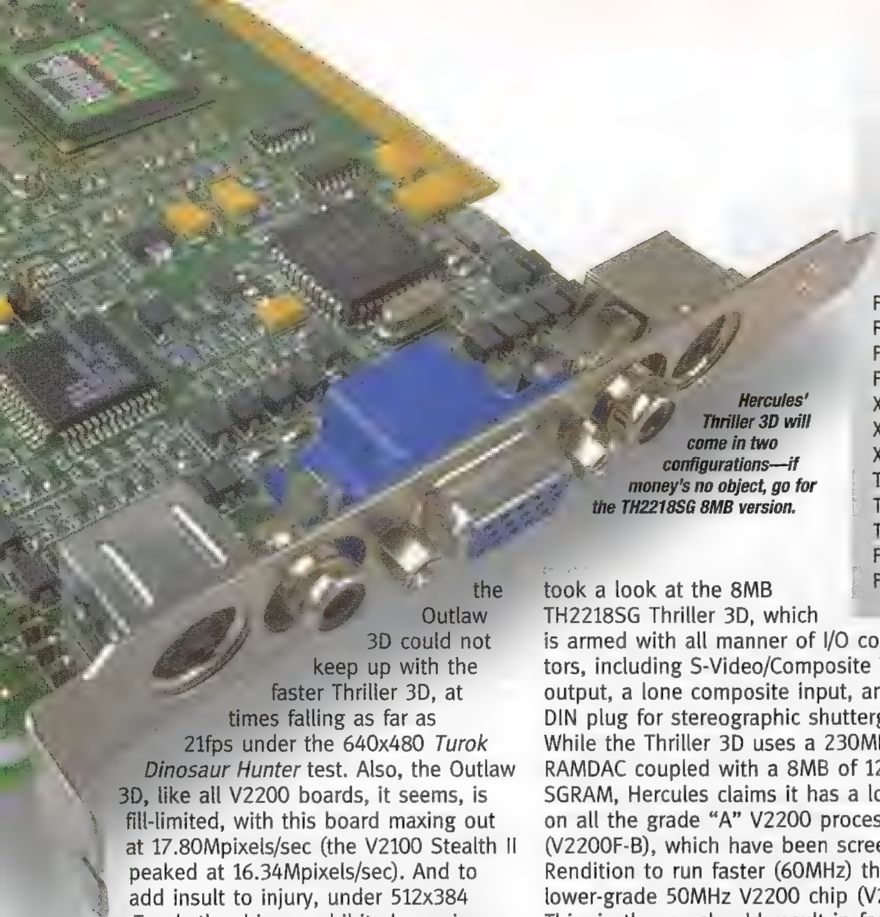
Under our battery of video-card benchmarks, the Outlaw 3D rode a seesaw of extremes. Under good ol' DOS, the Outlaw 3D easily outperformed the Thriller 3D, posting extremely impressive DOS *Quake* frame rates. Even at the low VGA ranges, where the Vérité family has historically had poor performance, the Outlaw 3D tore things up in a big way, posting a whopping 75.8fps at 320x240 compared to the Thriller 3D's good (but not great) 46.7fps. Under Win95, our slew of DirectDraw tests also gave the Outlaw 3D the thumbs-up, edging by the Thriller 3D at every turn.

But, when the pedal hit the polygon metal under Direct3D and OpenGL, the Outlaw 3D finally got caught. While the board posted an excellent 63.7fps at 640x480 *X* and pumped out faster *Final Reality* 25Pixel scores, it could not keep up with the Thriller 3D under our other benchmarks. From the ForsakenMark through our slew of OpenGL/*Quake* tests,





It may look fashionable decked out in blue, but Jazz's Outlaw 3D needs more efficient drivers in order to keep up with the rest.



Hercules' Thriller 3D will come in two configurations—if money's no object, go for the TH2218SG 8MB version.

Direct3D Performance

	Jazz Outlaw 3D	Hercules Thriller 3D
ForsakenMark (512x384)	62.60fps	58.00fps
ForsakenMark (640x480)	48.13fps	54.67fps
ForsakenMark (800x600)	35.75fps	41.21fps
ForsakenMark (1024x768)	failed	22.37fps
X (640x480)	63.70fps	55.90fps
X (800x600)	47.36fps	51.76fps
X (1024x768)	33.00fps	39.54fps
Turok (512x384)	failed	49.5fps
Turok (640x480)	24.7fps	46.5fps
Turok (800x600)	18.0fps	28.2fps
Final Reality 25Pixel	208.37kpoly/sec	197.40kpoly/sec
Final Reality Fill Rate	17.80Mpixels/sec	17.80Mpixels/sec

the Outlaw 3D could not keep up with the faster Thriller 3D, at times falling as far as 21fps under the 640x480 *Turok Dinosaur Hunter* test. Also, the Outlaw 3D, like all V2200 boards, it seems, is fill-limited, with this board maxing out at 17.80Mpixels/sec (the V2100 Stealth II peaked at 16.34Mpixels/sec). And to add insult to injury, under 512x384 *Turok*, the drivers exhibited massive Z-buffering errors, resulting in flickering polygons galore—this also occurred under *Jedi Knight*.

MPEG-1 playback fared best at 800x600, with 16- or 32-bit color depths maintaining a smooth, clean 24fps. At higher resolutions, the video starts getting a hair pixelated and choppy, dropping as low as 17.6fps at 1024x768/32-bit color.

It's a clean little board, and its DOS performance is pretty darned impressive, but Jazz needs to pump those drivers a bit harder if it wants to compete. Let's hope it does.

THE STATS: BIOS: 1.04.132 I Win95 Drivers: Rendition Reference drivers ***THE BUNDLE:*** Win95 Drivers I GL mini drivers

Price ***$149***
Company ***Jazz Multimedia***
Phone ***408.727.8900***
URL ***www.jazzmm.com***

boot verdict 7

Hercules **Thriller** 3D TH2218SG

At the other end of the V2200 feature-set spectrum lies Hercules' Thriller 3D. This board is available in either a 4MB featureless "Basic" version (the TH2204) or an 8MB feature-rich version (the TH2218SG), both in AGP 1x/DMA or PCI versions. We took a look at the 8MB TH2218SG Thriller 3D, which is armed with all manner of I/O connectors, including S-Video/Composite TV output, a lone composite input, and a DIN plug for stereographic shutterglasses. While the Thriller 3D uses a 230MHz RAMDAC coupled with a 8MB of 125MHz SGRAM, Hercules claims it has a lock on all the grade "A" V2200 processors (V2200F-B), which have been screened by Rendition to run faster (60MHz) than the lower-grade 50MHz V2200 chip (V2200-B). This, in theory, should result in faster overall performance.

Win95 installation proved uneventful—like Jazz, Hercules promises both NT4 and Win95 drivers for its board, but only Win95 drivers were available. In order to run amok in *GLQuake* and its ilk, we had to use the current Vérité mini GL driver, which is still experiencing growing pains. Hercules put its look and feel on the Rendition reference drivers, with options for TV output and refresh all within reach. But TV output has been relegated to Win95 640x480/60Hz output only, thanks in large part to the Brooktree 865 encoder chip—any other resolution or refresh is out of luck.

On the DOS performance tip, the Thriller 3D was surprisingly lackluster—while its 46.7fps is decent for 320x240 *Quake*, the Outlaw 3D spanked it hard by posting 71.8fps. Even in Win95, the Thriller 3D's MDK PerfTest of 111 failed to catch the 124 posted by the Outlaw 3D.

But, when you start pumpin' D3D or OpenGL games, watch out, 'cause this board has found its calling. Under the slew of *Quake*-based benchmarks, the Thriller 3D edged a few of frames past the Outlaw 3D on every test. With D3D, this board managed to keep a healthy lead on almost every benchmark, with its 54.67fps at 640x480 ForsakenMark and excellent 46.5fps under 640x480 *Turok*. Visual quality remained high throughout. Even MPEG-1 playback was smoother, with the Thriller 3D keeping up frame rates even at 1024x768/16-bit. Only when forced into 1280x1024 did the board choke—hard.

Despite this, the Thriller 3D comes strapped and ready to take on all your D3D or OpenGL needs—it is the fastest V2200-based board out there to date.

THE STATS: BIOS: 1.04.132 I Win95 Drivers: 0.69.3446 ***THE BUNDLE:*** Win95 Drivers I Incoming SE

Price ***$249***
Company ***Hercules***
Phone ***510.623.6030***
URL ***www.hercules.com***

boot verdict 8

Feature Set & 2D Performance

	Jazz Outlaw 3D	Hercules Thriller 3D
Max 24-bit resolution/refresh	1024x768/75Hz (32-bit)	**1152x864/75Hz (32-bit)**
Max 16-bit resolution/refresh	1280x1024/75Hz	**1600x1200/75Hz**
VESA 2.0 Support/BIOS flashable	**Yes/Yes**	**Yes/Yes**
Virtual Desktop Support	No	No
DOS Quake (320x240)	**71.8fps**	46.7fps
DOS Quake (640x480)	**24.3fps**	13.8fps
DOS Quake (800x600)	9.6fps	**10.5fps**
MDK PerfTest v1.4 (DirectDraw)	**124**	111
Final Reality Radial Blur (DirectDraw)	**29.76fps**	29.54fps
Final Reality Chaos Zoomer (DirectDraw)	**46.82fps**	46.42fps

Bold indicates better performance

Note: All performance results were obtained under the following system configuration: Computer: Micron Millennium XRU; CPU: Intel Pentium II 300MHz; O/S: Windows 95 OSR2.1 Build 1212b; Motherboard: Intel AN440 440LX AGPset (1 AGP, 2 PCI, 2 ISA, 1 PCI/ISA shared); Soundcard: Creative Labs AWE64 ISA; Monitor: Hitachi 19-inch

Micron **Millennia** XKU 300

No sell-out, no compromise

boot KICK ASS! PRODUCT

Micron's latest gaming machine flips a brazen bird at all the system manufacturers pimping $800 appliance computers. The XKU 300 is a zero-compromise muscle car that says power users *do* matter—and as a follow-up to the first desktop system ever to receive a bootVerdict of 10 (*boot* 13), Micron's beefiest computer proves the Millennia line is staying the kick-ass course.

Killer parts + killer performance = happy bootBoyz. It's simple mathematics, so why do so many manufacturers make concessions to mediocrity? Teaming a 300MHz Pentium II processor with the Diamond Viper V330 video card is a no-brainer—and that Riva 128–powered Direct3D juggernaut rides the AGP bus, no less. Both pieces of silicon fit nicely into the ATX Intel Atlanta motherboard. The 440LX core-logic chipset means you're confined to Slot 1 Deschutes if you decide to upgrade CPUs, but if you're not happy with the ample 64MB of SDRAM that comes stock, you can easily ramp up to 384MB by dropping some new DIMMs in those wide-open slots.

The CPU and video card produced stellar benchmark scores across-the-board, but what really impressed us was the 69.7fps in the *Foresaken* D3D test and the 30.5fps in the nonaccelerated *Quake* test. The XKU 300 is a whip-fast gaming machine, and its D3D visual quality appeared better than many other Riva 128–based systems we've reviewed (it's the drivers—it's *always* the drivers). You'll be ready to gun down bogies out-of-the-box with the Microsoft Sidewinder joystick and cranking Cambridge Soundworks Microworks speakers. The Hitachi GD-2000 DVD-ROM drive posted a solid 2114K/sec score in the CD-ROM read test, and the Chromatic E4 MPEG-2 decoder produced clean DVD movie output sans shearing. Unfortunately, the E4 lacks video-out for playing DVD movies on your TV set.

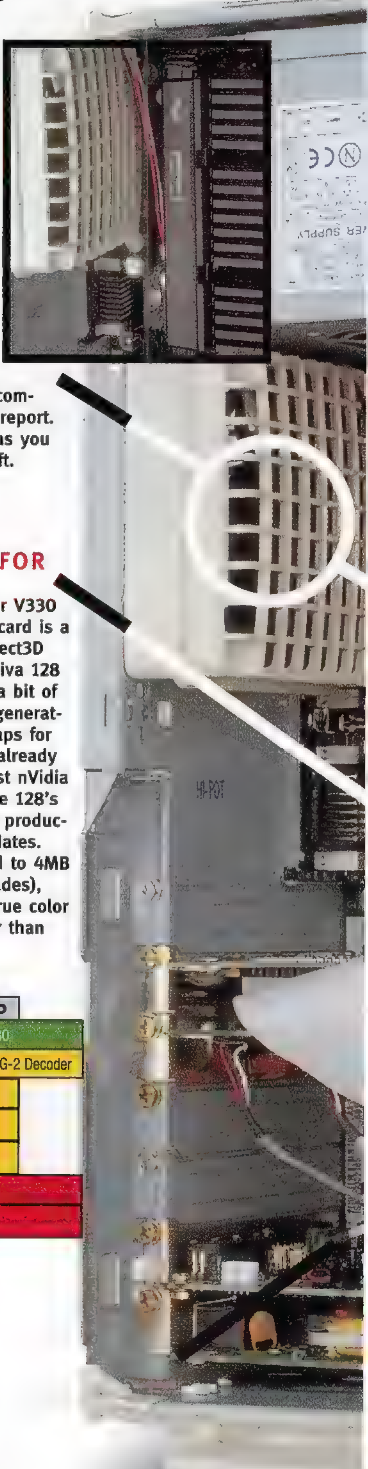
The 6.4GB IBM Deskstar hard drive performed admirably, transferring a sturdy 4.33MB/sec in this age of Ultra2 SCSI and fibre-channel hard drives. You also get a Zip drive, as well as a free 5.25-inch bay and another 3.5-inch bay, should you decide to install every other media format known to bootKind.

And so we turn to the two component categories that typically get short-shrift from stingy OEMs: the sound card and monitor. Sure, Micron could have gone the laughably ubiquitous Yamaha OPL-what-the-hell route, but instead you get a Creative Labs AWE64 for the best in old-fashioned ISA-style polyphony. The 19-inch Hitachi monitor uses the same Hitachi tube that every other 19-inch display used in 1997, but it's a bright, true CRT that perfectly complements the XKU's multimedia experience. Most importantly, Micron sells you the 19-incher for $600, more than $200 cheaper than the least-expensive 19-incher we've seen on store shelves.

If this configuration doesn't suit you, the XKU 300 can be built-to-order directly from Micron's web site. A dizzying array of upgrading and downgrading options will help you save money or ramp up to a workstation-level configuration. If you decide to upgrade components yourself, you'll have no trouble removing the single thumbscrew and sliding off the side panel.

As an update to the Millennia XRU, the XKU ditches a ViRGE/Voodoo video combo for nVidia's hybrid Riva 128, and moves forward with AGP and the 440LX core-logic chipset. These aren't transgressions, so how can we deny the top Millennia another 10 verdict? Simple: No Deschutes processor or PCI sound card. Fine points, sure enough, but the bar of perfection has been raised.

—*Jon Phillips*



FRIENDS CALL ME SNOW MISER

Pentium IIs tend to get hot and sweaty, so Micron is blowing a cruel wind from the north (off the power supply) as well as a chilly gale from the west (from a second auxiliary fan). Mongo heatsinks complete the weather report. Watch your head as you get off the chair lift.

OPTIMIZED FOR SPEED

The Diamond Viper V330 2D/3D AGP video card is a screaming-fast Direct3D machine, but its Riva 128 chipset sacrifices a bit of visual quality by generating low-res mipmaps for games that don't already have them. At least nVidia has cleaned up the 128's poor transparency production via driver updates. The card is limited to 4MB (no memory upgrades), so you can't get true color at anything higher than 1152x864.

under the hood

THE BRAINS	
CPU	Intel Pentium II 300MHz
L2 Cache	512K (internal)
RAM	64MB SDRAM (384MB max)
Motherboard	Intel Atlanta 440LX, ATX formfactor
THE BRAWN	
Video	AGP Diamond Viper V330 (Riva 128 chipset, 4MB SGRAM)
Hard Drive	IBM Deskstar 5, 6.4GB EIDE Ultra DMA/33
DVD-ROM	Hitachi GD-2000 with Chromatic E4 MPEG-2 decoder
Expansion	One AGP, three PCI, one ISA, one shared PCI/ISA
Fax/Modem	US Robotics 56.6Kbps Sportster (X2)
I/O Ports	Two USB, two serial, one parallel
THE BEAUTY	
Display	Hitachi CM751U; 19-inch; 0.26mm dot pitch; 1600x1200@75Hz
Sound	Creative Labs AWE64
Speakers	Cambridge Soundworks Microworks
Other	Iomega Zip Drive, Microsoft Intellimouse, Microsoft Sidewinder Joystick

EXPANSION MAP

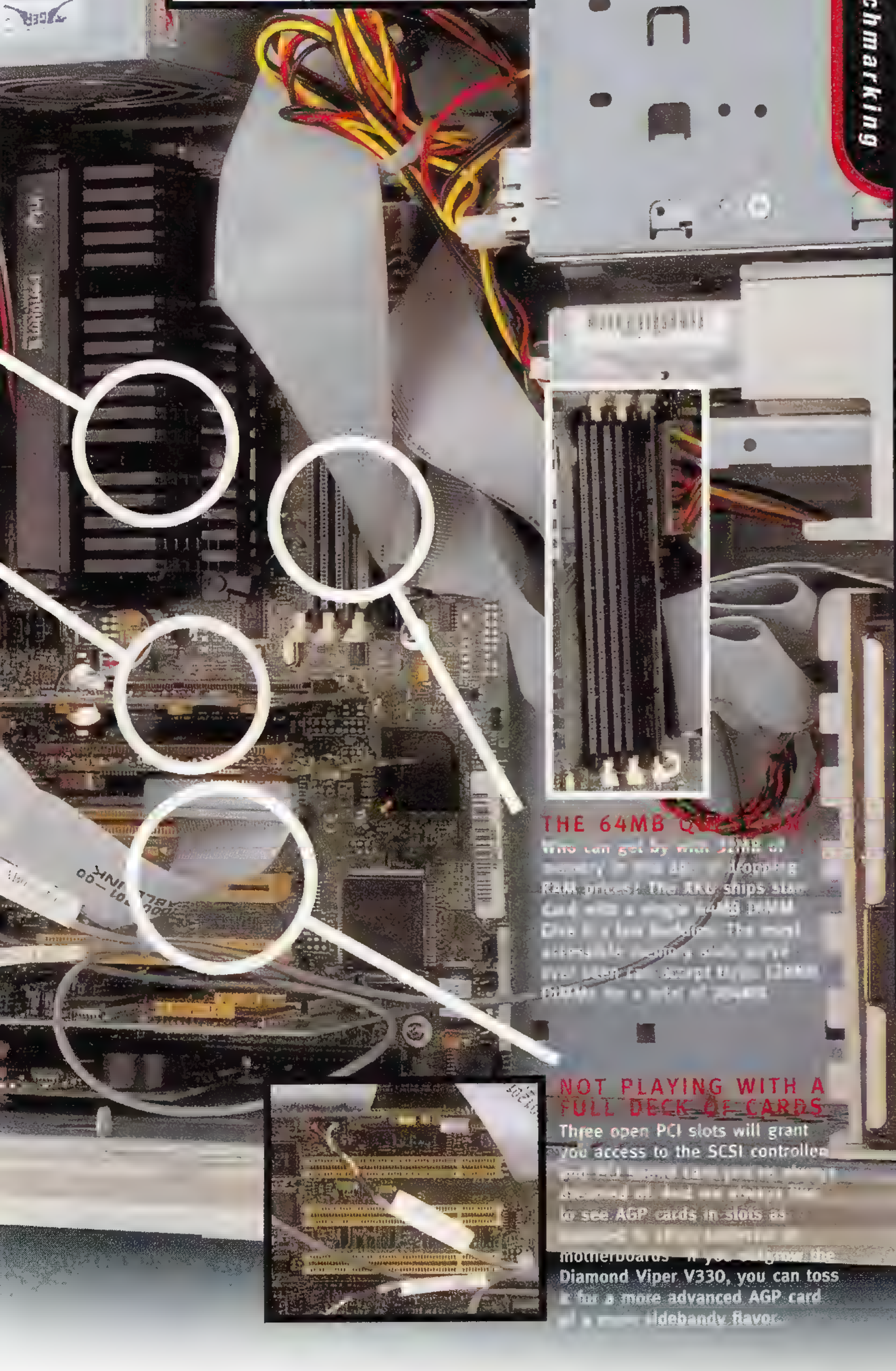
AGP	Diamond Viper V330
PCI	Chromatic E4 MPEG-2 Decoder
PCI	Free
PCI	Free
PCI	Free (shared)
ISA	AWE64 (shared)
ISA	Sportster modem

THE BUNDLE Microsoft Windows 95 Plus | MechWarrior 2: Mercenaries | Command and Conquer Gold | Jane's AH-64D Longbow | Jane's US Navy Fighters '97 | Formula 1 | Silent Steel (DVD) | Blockbuster Guide to Movies (DVD)

boot	down
:51	:09

BUMP FOR YOUR TRUNK

Multimedia speakers or offensive weapons? The Cambridge Soundworks Microworks will accommodate any Quake fragger who wants to piss off his neighbors. The subwoofer emits bass that you feel in your bones, and the satellites handle the sweeping mids and high of your most demanding jazz CDs. We love these speakers!



THE 64MB QUESTION

Who can get by with 32MB of memory in this day of dropping RAM prices? The XKU ships standard with a single 64MB DIMM. Give it a few birthdays. The most accessible memory slots we've ever seen can accept three 128MB DIMMs for a total of [illegible].

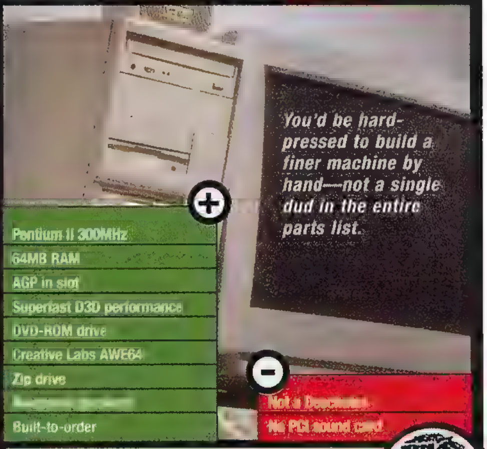
NOT PLAYING WITH A FULL DECK OF CARDS

Three open PCI slots will grant you access to the SCSI controller [illegible] dreamed of. And we always like to see AGP cards in slots as [illegible] motherboards—if you outgrow the Diamond Viper V330, you can toss it for a more advanced AGP card of a more sidebandy flavor.

real-world benchmarking

Micron Millennia XKU 300

Test	Benchmark	Unit	Score
CPU/MOTHERBOARD	bootMark		142
WIN95 APPS	SYSmark32		304
DIRECT3D	Terramark	composite	69.7
HARD DRIVE	Adaptec ThreadMark v1.0	MB/sec	4.33
DVD-ROM	CD Tach/Pro v1.65	K/sec	2114
WIN95 VIDEO	VidTach v1.52	% played	100
DOS GAMING	Quake v1.06	fps	30.5
DIRECTX GAMING	MDK PerfTest v1.4		127
MMX PROCESSING	DeBabelizer Pro	secs	203
CPU/DISK	Microsoft Visual C++ compile	secs	87



You'd be hard-pressed to build a finer machine by hand—not a single dud in the entire parts list.

+

- Pentium II 300MHz
- 64MB RAM
- AGP in slot
- Superfast D3D performance
- DVD-ROM drive
- Creative Labs AWE64
- Zip drive
- [illegible]
- Built-to-order

−

- Not a Deschutes
- No PCI sound card

Price $2,848 (as configured); $3,448 (with 19-inch monitor)
Company Micron
Phone 800.209.9686
URL www.micronpc.com

boot verdict 9

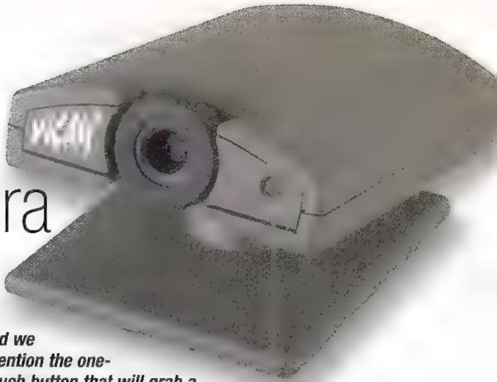
complete breakdown of benchmark results is available the *bootNet*. Point your browser to www.bootnet.com.

BEIGE, KHAKI, TAUPE, CREAM, OR OFF-WHITE?

A forward-thinking company like Micron should come up with zanier color schemes. Where are the blues, blacks, and purples? Sigh.

ViCAM Color Digital Video Camera

I've seen things you people wouldn't believe

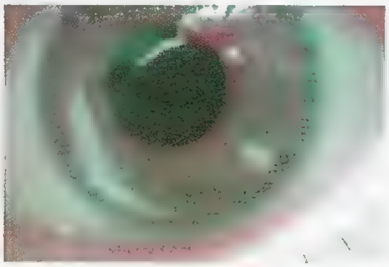


Did we mention the one-touch button that will grab a TWAIN snapshot or start/stop an AVI?

boot KICK ASS! PRODUCT

Probably the only thing cooler than a still digital camera is a motion digital video camera, and we're hard-pressed to find one that performs as astounding as the miniscule ViCAM camera does, in any price range.

Connecting to the parallel port (and providing a pass-thru) via a 9-foot cable and completely powered by a PS/2-style keyboard port, this camera picks up where the popular Connectix Quick-Cam leaves off. The picture quality is sharp, detailed, with bright colors responding up to 40fps in black and white and 30fps in color mode on an EPP port. As if that weren't enough, this AVI/TWAIN-compliant device has the option to swap out its multi-element glass lens from the included 6mm/f:2.0 to an 8.0mm/f:2.5 or f:2.0 in either 12.0mm or 3.6mm. There are six resolutions, ranging from 160x120 up to a staggering 1280x960 (interpolated). Automatic White Balance (AWB), less than 1 lux sensitivity, 4Hz to 60Hz scanning, and shutter controls of 1/4 to 1/30,000 of a second make the ViCAM superior to all other cameras in low-light conditions.



This close-up of my eye reveals that I wear blue colored contacts. Notice also the reflection of my finger and the camera in the shot. We tried to get an image of the inside of my retina but couldn't get a light source directed into it without the pupil closing. Damn.

Included in the bundle are a comprehensive video/still-image grabber and camera-tweaking tool named *ViView*, MGI *PhotoSuite SE* and *VideoWave SE Plus*, and a demo of *FaceIt PC* biometric face-recognition and en/decryption program with a $30 rebate coupon. The base is solid and provides for a wide degree of swivel, and yes, the LED can be turned off via software. The focus control was too sensitive; we would prefer a dial that advanced in incremental clicks, but for the amount of detail it allows we're not complaining.

Yeah, it's a keeper.

—*Daevid Vincent*

Price $200
($50 for 3 lens kit)
Company Vista Imaging
Phone 650.802.9685
URL www.vistaimaging.com

boot verdict 10

G-Police

Symphony of destruction

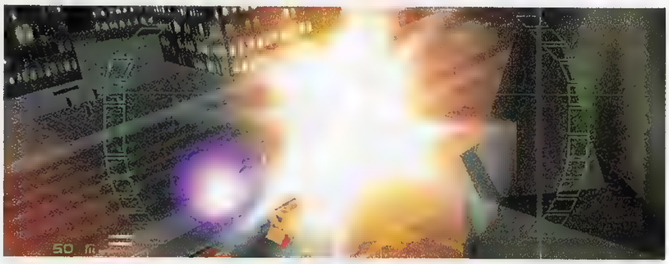
TRY IT ON THE DISC

The first AGP title, *G-Police* delivers some of the most lavish graphics ever to hit your Direct3D card. Glowing weapons slam into aircraft that spiral down to a fiery explosion, casting ambient hues on the surrounding cityscape. However, while *G-Police* is a showcase of state-of-the-art hardware acceleration, several design flaws keep it from becoming a truly great game.

Presented for your viewing pleasure are oodles of semi-translucent shockwave explosions, dazzling dynamic lighting effects, and highly detailed texture maps. Aggressive use of alpha-blending confers upon everything—from the white afterglow of missile trails to the red and blue flash of police sirens—the eye-pleasing subtlety of real-world radiance. On a Rendition or 3Dfx card the frame rates consistently hover around the mid-20s at 640x480. AGP ups the ante with more frames of animation and higher-resolution explosions, as well as FMV billboards, à la *Blade Runner.*

CHECKLIST
G-Police
Version: 1.18
Maximum Resolution/Color
1600x1200/32-bit
Win95 Native
3D Acceleration
Direct3D
DirectX
DirectDraw DirectSound
DirectInput
Specialty Controllers
Force feedback
Win95 compatible

Advanced sound support is offered through both Q-Sound and Dolby surround modes. While it's nice to experience intense firefights with the advanced stereo effects, the cacophony of weapons barrages and explosions drowns out your instructions from headquarters.



G-Police's brilliant explosions light up the night sky as well as the surrounding buildings.

G-Police's arcade-like physics model doesn't allow many advanced flight maneuvers. Your anti-gravity helicopter is limited to linear movements. No lateral movement is allowed, even though strafing would come in handy. You can't loop, and you're curiously locked out of attitude controls when your nose is pointed at a target. Force feedback is supported, but for some reason it slows frame rates to a crawl when enabled.

Unfortunately, extremely difficult missions with unclear motives are the only way to enjoy the game's intense visuals, since multiplayer support is absent. The game follows a linear storyline, allowing passage to the next level only when you've beaten the one before it. It's easy to get stuck in mission-repeat purgatory.

While *G-Police* pays intense attention to graphical detail, difficult missions and control problems move compelling gameplay off the scope.

—*Sean Downey*

Price $50
Developer Psygnosis
Publisher Psygnosis
Phone 800.438.7794
URL www.psygnosis.com

boot verdict 7

Ray **Dream** 3D

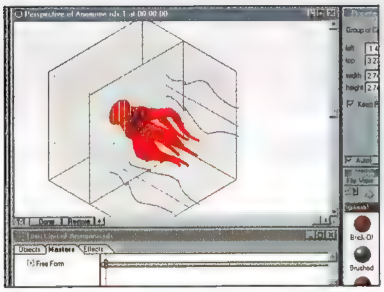
Baby's first 3D steps

With practice, you can create fabulous 3D scenes like this and impress your friends.

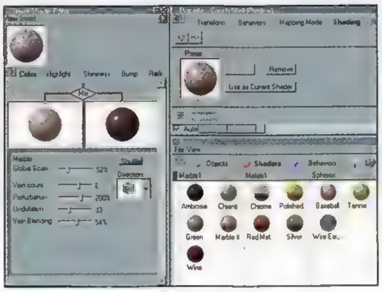
Ray Dream 3D is a great launching pad for your 3D dreams. For less than a C-note, this beginner's 3D modeler/renderer/animator/texture editor will prep you for hardcore, pro-caliber 3D applications, such as *RD3D*'s big brother, *Ray Dream Studio 5.*

In fact, *RD3D*'s rendering engine is the same as *Studio*'s, minus a few models and shaders, and without symmetrical processor support for speedy rendering of mega-poly models. But these limitations result in a simpler interface that lets anyone create the next *Babylon 5*, or at least the next *Tron.*

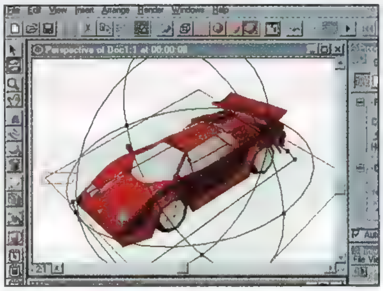
The SceneWizard provides step-by-step guidance to help you create your first 3D scene, based on one of four types of basic scenes: 3D logo design, indoor scenes, outdoor scenes, and a *PhotoStudio* mode. Not 30 seconds after the simple installation, we were rendering our first 3D masterpiece without even cracking the spine of the manual. And in a few hours, the included tutorial will brief you on positioning your objects in a 3D world, free-form modeling, texturing objects with shaders, lighting your scene, and positioning your camera correctly. Invest a little more time and learn the art of key-frame animation.



The Free Form modeler used to create 3D objects involves manipulation of geometric shapes on the Cross Section plane and the Sweep Path plane.

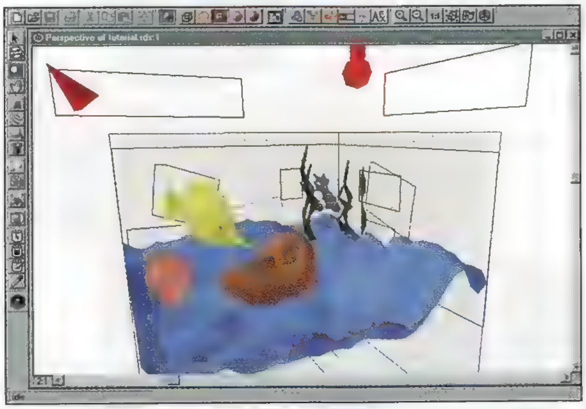


The Current Shader Editor allows control over eight different properties of any given shader. It comes with over 400 custom shaders.



You can customize the layout of your workspace so that all the tools you might need are at your fingertips.

Right from the get-go, you'll be dragging-and-dropping objects from the Browser palette's 700 animation-ready models to your scene, applying textures and other attributes from the same palette. And basic animation is as easy as dragging a behavior—such as "Bounce"—from the Browser palette onto the target object.



When working on your scene, you'll create it in a working box, which has three grid planes for X, Y, and Z. You can choose from various view options to view your scene on the fly (shown in Fast Preview mode).

Still, while you can create cookie-cutter scenes using the SceneWizard, don't start bidding against ILM for the next *Star Wars* trilogy just yet. Thinking and creating in 3D—via the free-form modeler—is much harder than living in it. And creating custom textures with the shader editor is an equally taxing task.

To make matters easier, *RD3D* comes with 400 custom shaders and over 100 light and camera presets. When you get ambitious, you can tweak the render controls, such as adding atmospheric conditions such as fog and ambient light.

When you've created your polygon Picasso, *RD3D* imports and exports formats such as JPEG, TIF, AVI, TARGA, DXF, 3DMF, BMP, GIF, RIF, PCX, *Corel Photo-Paint*, and *Photoshop* files. And vector-based files from *Adobe Illustrator* or *CorelDraw* can be imported directly into the free-form modeler, perfect for converting the company logo into a rotating 3D gif for the corporate web site or warez front.

Despite a few missing features, *RD3D* is a steal at a hundred bucks. The SceneWizard alone is worth the price of admission and will have you churning out 3D masterpieces from the moment you fire this baby up.

—Erik Piller

boot verdict 8

Price $99
Company MetaCreations
Phone 805.566.6200
URL www.metacreations.com

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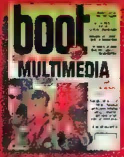
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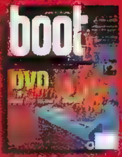
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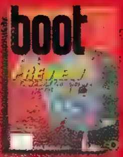
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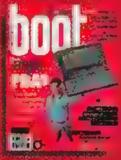
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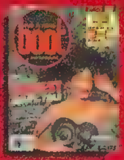
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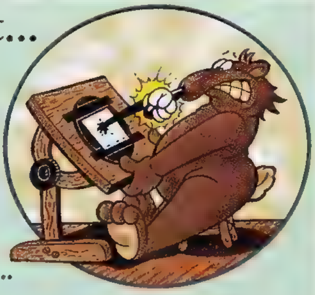

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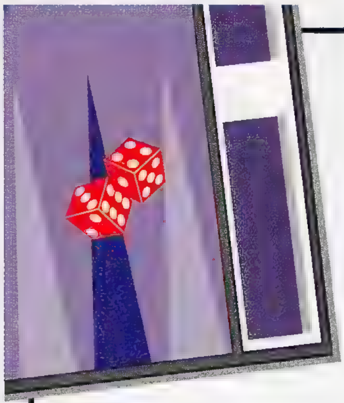

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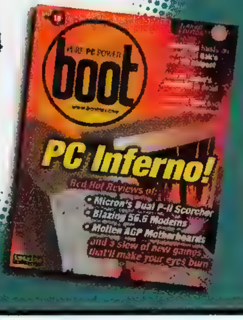
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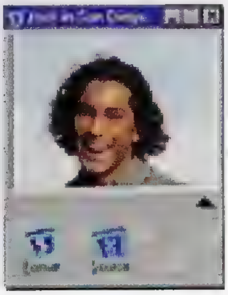

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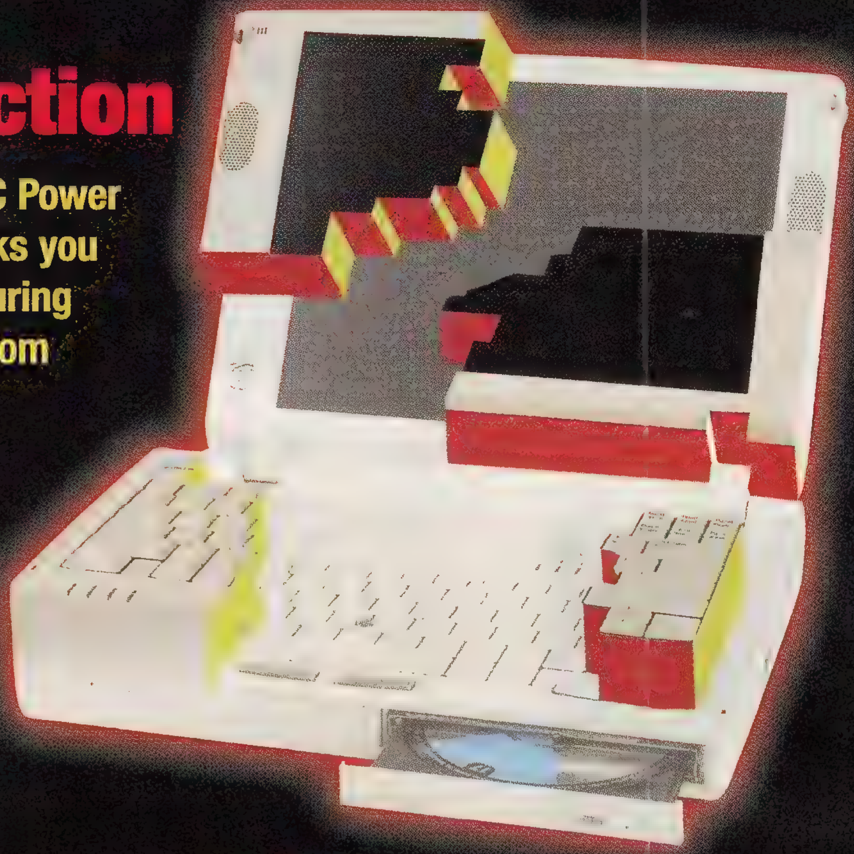

Public Displays of Affection

Do you love your PDA or do you *love* your PDA? *boot* rounds up its favorite Personal Digital Assistants, and gives 'em a big wet kiss on their LCD displays. Add a whole new dimension to your mobile mini-computing love affair.

bootWorthy Modems

Look at all the pretty lights! We pillaged Modemland and brought back the booty that will change your online lifestyle forever: 56.6Kbps, ISDN, PC cards—and the new bonded analog modems that promise 112Kbps. Alt. binaries.pictures, here we come!

The Truth About Core-Logic Chipsets

Your superfast CPU ain't jack unless it's teamed up with the right core-logic chipset. Here's a hint: It sits on your motherboard and directs all the bus traffic from here to Carson City, Nevada. Learn more about your computer in the Motherboard of All White Papers.

ISSUE NUMBER 20
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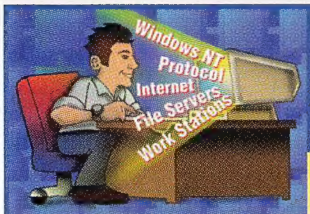

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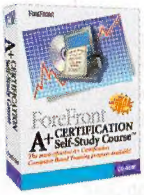

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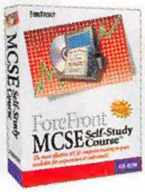

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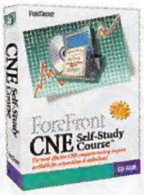

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The Glitch Chronicles: Where Are They Now?

The Glitch Comedy Hour has been entertaining the masses since its first broadcast in 1962. But what has become of all the troupe members? Here's an update on your favorite back-page personalities.

THE THIRD GUY • *boot 01*

Previously employed by Five Guys Software, the Third Guy is now chief technology officer for Six Dudes With Play Money, a Silicon Valley start-up that specializes in stripping naked and rolling around in piles of venture capital. The Third Guy replaces the Fourth Dude, who was forced to resign after sexually harassing the Only Hot Chick.

FRANCIS • *boot 05*

When we last left our parsimonious computer novice, Francis had just purchased a PDA that was to fulfill all his computing needs. Unfortunately, Francis was robbed and beaten to death outside of the computer store, and his PDA is now being used by a crack dealer to keep track of his inventory.

JACK KELLMORE • *boot 06*

Despite protests from surrounding townspeople, the billionaire industrialist is proceeding with his plan to lift his entire Feedbag, Nebraska, chip fab plant three feet off the ground and move it 90 degrees clockwise so he can get a perfect view of the setting sun when he smokes cigars on the factory's back loading dock. In other developments, Kellmore is changing his first name to "JackBenet" because it makes him feel pretty.

CHIEF BAGOGO • *boot 07*

Our beloved news editor has taken to locking himself in the bootLab where he practices a multicultural melange of Santeria rites and traditional Canadian cooking rituals. "Don't worry," says Bagogo when he emerges from the lab with a boiling cauldron of indeterminate stink. "This time I made it *without* the mojo."

THE CLIP ART GIRL • *boot 10*

Little Linda Collins, who helped draw worldwide attention to the horrors of child labor in clip art sweatshops, has broken free of her shackles and is now just a normal, healthy 4th grader. Her favorite subject is Computer-Assisted Arts and Crafts. "I still got it," says Collins. "And when Mrs. Reynolds asks for a picture of a bunny rabbit, I give her a bunny rabbit. None of that 'I-can't-color-between-the-lines' crap that the 3rd graders are pushing."

SILICON "JACK" APOLLO • *boot 11*

Having lost the crown of World's Number One Fully Decked Cyber-Dude to a human-cyborg half-breed, Mr. Apollo is now training diligently to win back the top seed. This summer, he will upgrade his liver with a 4.5GB Seagate Cheetah hard drive and undergo surgery to remove another 20lbs. of unnecessary muscle mass.

MR. BROWN • *boot 13*

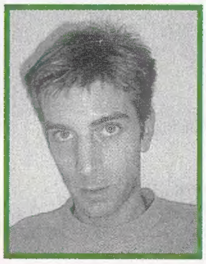
09/26/97—11/03/97

boot's latest hire was accidentally electrocuted during an overclocking exercise at the bootCamp facility in New Hope, Kentucky. We are currently looking for another young buck who's ready to jumper his way into popular legend.

JACKIE AMICO • *boot 14*

The purveyor of all cards ISA has added a new hardware catalog—Jacqueline Amico's Gentle Living—to his spring line-up. Sale items include ISA tea doilies, ISA porcelain figurines, and ISA manger scenes. "We've found old ladies prefer the ISA bus because it's more their speed," says Amico, adding that his delicate ISA collectibles "actually run a lot slower if you put them in a hutch instead of a motherboard."

CODY CAMARO • *boot 18*



The lead developer of *Timmy Got Popped* lost the libel suit against himself and now just hangs out at the half pipe and sells himself fake pot.

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